5.3 WASTE MANAGEMENT ALTERNATIVES

This section describes the potential long-term environmental impacts associated with the implementation of alternatives for administering ongoing solid waste management operations and proposed disposal of low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW) from Hanford and a limited volume of offsite LLW and MLLW in an IDF located at Hanford. Specifically, this includes the management and disposal of LLW and MLLW from tank closure activities, as described in Chapter 4, Section 4.1.14, as well as other non–Comprehensive Environmental Response, Compensation, and Liability Act (non-CERCLA) LLW and MLLW from Hanford, including the waste from FFTF decommissioning described in Chapter 4, Section 4.2.14, and waste from other DOE sites (i.e., offsite waste). This section analyzes the impacts of expanding Hanford's waste disposal capacity to provide space for onsite and offsite waste; this section also includes an analysis of associated storage, disposal, and closure activities, as well as facility-specific construction, operations, deactivation, and closure activities.

Three Waste Management alternatives were considered and analyzed, including (1) Waste Management Alternative 1: No Action; (2) Waste Management Alternative 2: Disposal in IDF, 200-East Area Only; and (3) Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas.

Waste Management Alternative 1 would include storing and disposing of LLW and MLLW in trenches 31 and 34 of existing Low-Level Radioactive Waste Burial Ground (LLBG) 218-W-5 and storing and disposing of transuranic (TRU) waste in the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. No offsite waste would be received; construction/use of the IDF located in the 200-East Area (IDF-East) would be discontinued; and IDF-East would be deactivated.

Waste Management Alternative 2 would include storing LLW, MLLW, and TRU waste in the Central Waste Complex (CWC) prior to disposal and processing waste prior to disposal at new facilities or existing-facility expansions at the CWC, Waste Receiving and Processing Facility, and the T Plant. A total volume of 62,000 cubic meters (2.2 million cubic feet) of LLW and 20,000 cubic meters (706,300 cubic feet) of MLLW from other DOE sites would be received for disposal under this alternative. Waste from tank closure and treatment operations, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites would be disposed of in IDF-East. A new RPPDF would be constructed for disposal of lightly contaminated equipment and soils as a result of tank farm clean closure activities.

Waste Management Alternative 3 would involve the same waste storage and processing provisions as Waste Management Alternative 2 and the same volume of offsite waste accepted for disposal; a new RPPDF would also be constructed. However, an additional IDF would be constructed in the 200-West Area (IDF-West). Waste from tank closure and treatment operations would be disposed of in IDF-East, while that from onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites would be disposed of in IDF-West.

In addition, under each Waste Management action alternative (i.e., Alternatives 2 and 3), three disposal groupings were analyzed: Disposal Groups 1, 2, and 3. These disposal groupings encompass the sizing requirements and associated construction, operations, and closure requirements for the IDF(s) and RPPDF necessary to accommodate the varying waste volumes considered under each disposal configuration. These alternatives and options are described further in Chapter 2, Section 2.5, of this EIS.

These disposal groupings are further divided into subgroupings for the consideration of the different types and volumes of waste generated from the 10 Tank Closure action alternatives and the 2 FFTF Decommissioning action alternatives to analyze the long-term impacts associated with disposal of the various waste types and volumes. These subgroupings are described in Table 5–92.

Table 5–92. Waste Management Action Alternative Subgroupings

Waste Management Alternative	Disposal Group and Subgroup	Disposal Location	Tank Closure Alternative Waste	Other DOE Waste
1	N/A	LLBG 218-W-5, trenches 31 and 34	N/A	Non-CERCLA waste
2	Disposal Group 1, Subgroup 1-A	IDF-East	Tank Closure Alternative 2B • ILAW glass • LAW melters • Secondary waste (LLW and MLLW)	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 2B • Closure waste (LLW and MLLW)	N/A
2	Disposal Group 1, Subgroup 1-B	IDF-East	Tank Closure Alternative 3A • ILAW glass • Bulk vitrification glass • LAW melters • Secondary waste (LLW and MLLW)	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 3A • Closure waste (LLW and MLLW)	N/A
2	Disposal Group 1, Subgroup 1-C	IDF-East	Tank Closure Alternative 3B • ILAW glass • Cast stone waste • LAW melters • Secondary waste (LLW and MLLW)	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 3B • Closure waste (LLW and MLLW)	N/A
2	Disposal Group 1, Subgroup 1-D	IDF-East	Tank Closure Alternative 3C • ILAW glass • Steam reforming waste • LAW melters • Secondary waste (LLW and MLLW)	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 3C • Closure waste (LLW and MLLW)	N/A
2	Disposal Group 1, Subgroup 1-E	IDF-East	Tank Closure Alternative 4 • ILAW glass • Bulk vitrification glass • Cast stone waste • LAW melters • Secondary waste (LLW and MLLW)	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 4 • Closure waste (LLW and MLLW)	N/A

Table 5–92. Waste Management Action Alternative Subgroupings *(continued)*

Waste Management Alternative	Disposal Group and Subgroup	Disposal Location	Tank Closure Alternative Waste	Other DOE Waste
2	Disposal Group 1, Subgroup 1-F	IDF-East	Tank Closure Alternative 5 • ILAW glass • Bulk vitrification glass • Cast stone waste • Sulfate grout • LAW melters • Secondary waste (LLW and MLLW)	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	N/A	N/A
2	Disposal Group 1, Subgroup 1-G	IDF-East	Tank Closure Alternative 6C • Secondary waste (LLW and MLLW)	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 6C • Closure waste (LLW and MLLW)	N/A
2	Disposal Group 2, Subgroup 2-A	IDF-East	Tank Closure Alternative 2A • ILAW glass • LAW melters • Secondary waste (LLW and MLLW)	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	N/A	N/A
2	Disposal Group 2, Subgroup 2-B	IDF-East	Tank Closure Alternative 6B, Base and Option Cases • PPF melters • PPF glass • Secondary waste (LLW and MLLW)	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 6B, Base and Option Cases • Closure waste (LLW and MLLW)	N/A
2	Disposal Group 3	IDF-East	Tank Closure Alternative 6A, Base and Option Cases • PPF melters • PPF glass • Secondary waste (LLW and MLLW)	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 6A, Base and Option Cases • Closure waste (LLW and MLLW)	N/A

Table 5–92. Waste Management Action Alternative Subgroupings *(continued)*

Waste Management Alternative	Disposal Group and Subgroup	Disposal Location	Tank Closure Alternative Waste	Other DOE Waste
3	Disposal Group 1, Subgroup 1-A	IDF-East	Tank Closure Alternative 2B • ILAW glass • LAW melters • Secondary waste (LLW and MLLW)	N/A
		IDF-West	N/A	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 2B • Closure waste (LLW and MLLW)	N/A
3	Disposal Group 1, Subgroup 1-B	IDF-East	Tank Closure Alternative 3A • ILAW glass • Bulk vitrification glass • LAW melters • Secondary waste (LLW and MLLW)	N/A
		IDF-West	N/A	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 3A • Closure waste (LLW and MLLW)	N/A
3	Disposal Group 1, Subgroup 1-C	IDF-East	Tank Closure Alternative 3B • ILAW glass • Cast stone waste • LAW melters • Secondary waste (LLW and MLLW)	N/A
		IDF-West	N/A	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 3B • Closure waste (LLW and MLLW)	N/A
3	Disposal Group 1, Subgroup 1-D	IDF-East	Tank Closure Alternative 3C • ILAW glass • Steam reforming waste • LAW melters • Secondary waste (LLW and MLLW)	N/A
		IDF-West	N/A	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 3C • Closure waste (LLW and MLLW)	N/A

Table 5–92. Waste Management Action Alternative Subgroupings *(continued)*

Waste Management Alternative	Disposal Group and Subgroup	Disposal Location	Tank Closure Alternative Waste	Other DOE Waste
3	Disposal Group 1, Subgroup 1-E	IDF-East	Tank Closure Alternative 4 • ILAW glass • Bulk vitrification glass • Cast stone waste • LAW melters • Secondary waste (LLW and MLLW)	N/A
		IDF-West	N/A	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 4 • Closure waste (LLW and MLLW)	N/A
3	Disposal Group 1, Subgroup 1-F	IDF-East	Tank Closure Alternative 5 • ILAW glass • Bulk vitrification glass • Cast stone waste • Sulfate grout • LAW melters • Secondary waste (LLW and MLLW)	N/A
		IDF-West	N/A	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	N/A	N/A
3	Disposal Group 1, Subgroup 1-G	IDF-East	Tank Closure Alternative 6C • Secondary waste (LLW and MLLW)	N/A
		IDF-West	N/A	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 6C • Closure waste (LLW and MLLW)	N/A
3	Disposal Group 2, Subgroup 2-A	IDF-East	Tank Closure Alternative 2A • ILAW glass • LAW melters • Secondary waste (LLW and MLLW)	N/A
		IDF-West	N/A	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	N/A	N/A

Table 5–92. Waste Management Action Alternative Subgroupings *(continued)*

Waste Management Alternative	Disposal Group and Subgroup	Disposal Location	Tank Closure Alternative Waste	Other DOE Waste
3	Disposal Group 2, Subgroup 2-B	IDF-East	Tank Closure Alternative 6B, Base and Option Cases • PPF melters • PPF glass • Secondary waste (LLW and MLLW)	N/A
		IDF-West	N/A	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 6B, Base and Option Cases • Closure waste (LLW and MLLW)	N/A
3	Disposal Group 3	IDF-East	Tank Closure Alternative 6A, Base and Option Cases • PPF melters • PPF glass • Secondary waste (LLW and MLLW)	N/A
		IDF-West	N/A	FFTF decommissioning waste Onsite secondary waste Non-CERCLA waste Offsite waste
		RPPDF	Tank Closure Alternative 6A, Base and Option Cases • Closure waste (LLW and MLLW)	N/A

Key: CERCLA=Comprehensive Environmental Response, Compensation, and Liability Act; DOE=U.S. Department of Energy; FFTF=Fast Flux Test Facility; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; ILAW=immobilized low-activity waste; LAW=low-activity waste; LLBG=low-level radioactive waste burial ground; LLW=low-level radioactive waste; MLLW=mixed low-level radioactive waste; N/A=not applicable; PPF=Preprocessing Facility; RPPDF=River Protection Project Disposal Facility.

5.3.1 Groundwater

5.3.1.1 Waste Management Alternative 1: No Action

This section describes the groundwater analysis results for Waste Management Alternative 1, including long-term groundwater impacts of contaminant sources within the barrier over trenches 31 and 34. Impacts of sources remaining within the tank farm barriers are presented in Section 5.1, which discusses tank closure impacts. Impacts of sources remaining within the FFTF barrier are presented in Section 5.2, which discusses FFTF decommissioning impacts.

5.3.1.1.1 Actions and Timeframes Influencing Groundwater Impacts

Summaries of the proposed actions and timelines for Waste Management Alternative 1 are provided in Chapter 2, Section 2.5. For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 1, as follows:

- The disposal period was assumed to start with the onset of disposal operations in LLBG 218-W-5, trenches 31 and 34, in CY 2008 and continue through CY 2035, when the trenches would be operationally closed. During this time, these trenches have accepted, and would continue to

accept, onsite non-CERCLA LLW and MLLW. During the disposal period, the materials in this permitted, operational facility would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2036 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in the trenches would become available for release to the environment. Assessment of short-term impacts for Waste Management Alternative 1 does not include construction of a barrier over trenches 31 and 34. However, the surrounding LLBG 218-W-5, which is included in the cumulative impacts analysis, would have a barrier emplaced consistent with the cumulative impacts analysis end-state methodology (see Appendix S). For the purpose of analyzing long-term groundwater impacts under Waste Management Alternative 1, trenches 31 and 34 were assumed to be covered by a barrier that limits infiltration for the first 500 years of the post-disposal period.

5.3.1.1.2 COPC Drivers

A total of 40 COPCs were analyzed for Waste Management Alternative 1. Complete results for all 40 COPCs are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 1 is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 1 were selected by evaluating the risk or hazard associated with all 40 COPCs in the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 1.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

5.3.1.1.3 Analysis of Release and Mass Balance

This section presents the impacts of Waste Management Alternative 1 in terms of the total amount of COPCs released to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms (see Figures 5–358 through 5–363). Two subtotals are plotted, representing releases from trenches 31 and 34. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over three orders of magnitude.

Figure 5–358 shows the estimated release to the vadose zone of the radiological risk drivers and Figure 5–359, the chemical hazard drivers. For both sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Trenches 31 and 34 are equal sources for all COPCs.

Figure 5–360 shows the estimated release to groundwater of the radiological risk drivers and Figure 5–361, the chemical hazard drivers. In addition to the inventory considerations discussed in the

previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All COPCs act as conservative tracers, and essentially all of the release to the vadose zone reaches groundwater in the analysis.

Figure 5–362 shows the estimated release from trenches 31 and 34 to the Columbia River of the radiological risk drivers and Figure 5–363, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In all cases, nearly 100 percent of the amount released to groundwater reaches the Columbia River in the analysis.

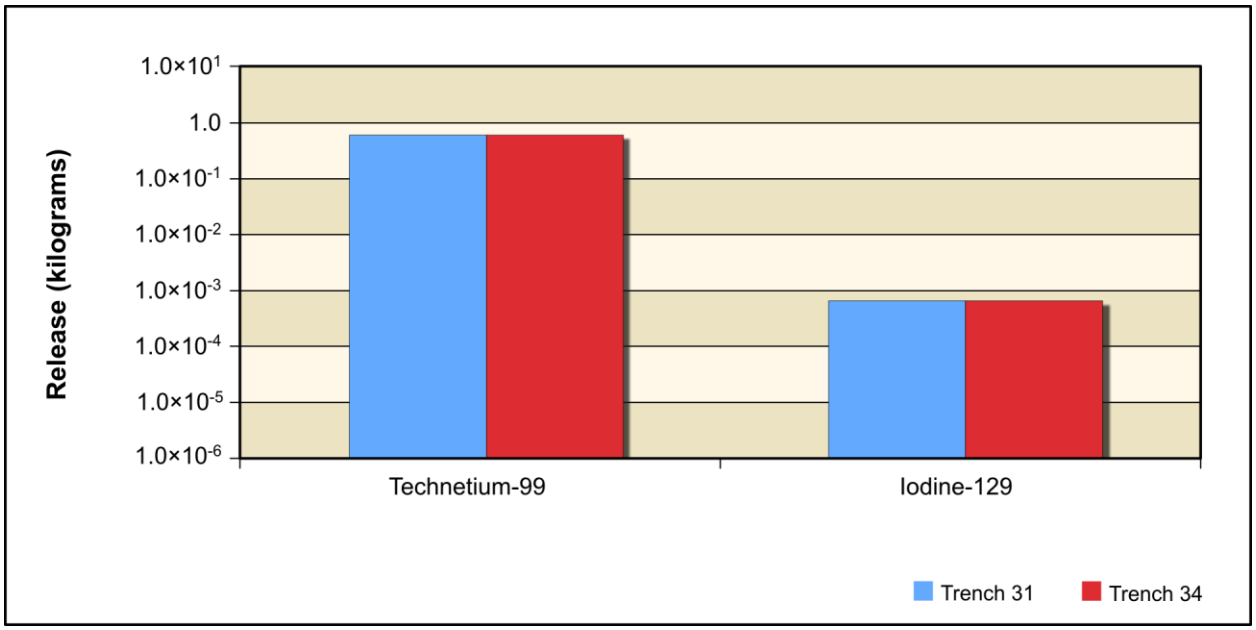


Figure 5–358. Waste Management Alternative 1 Radionuclide Releases from Trenches 31 and 34 to Vadose Zone

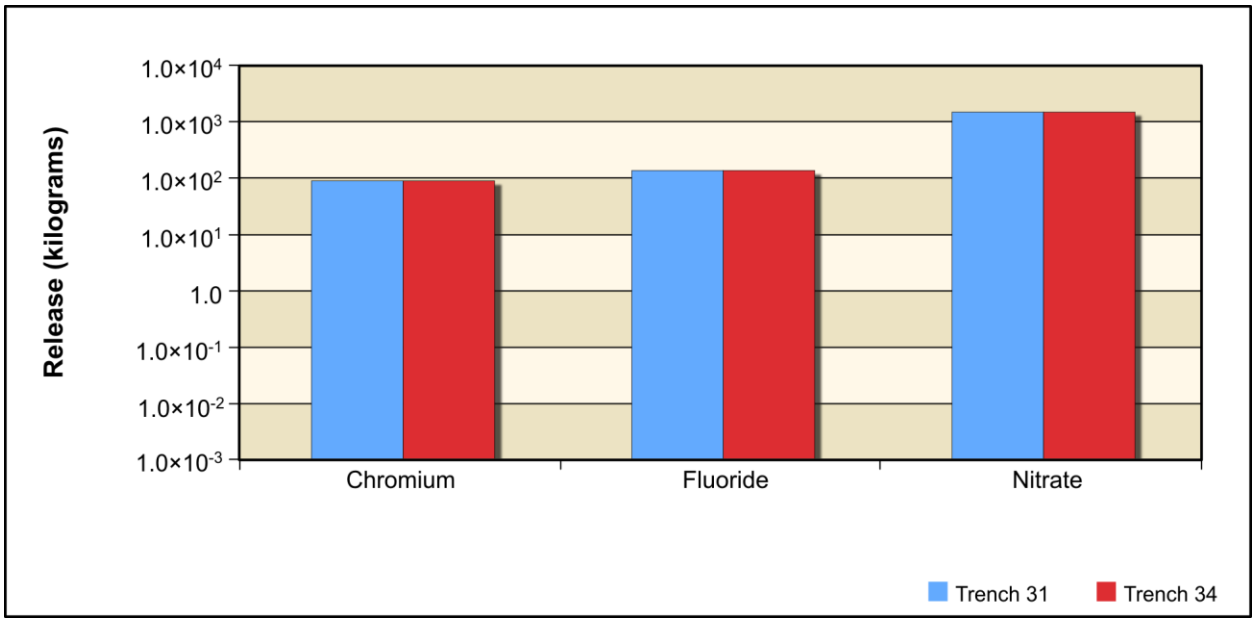


Figure 5–359. Waste Management Alternative 1 Chemical Releases from Trenches 31 and 34 to Vadose Zone

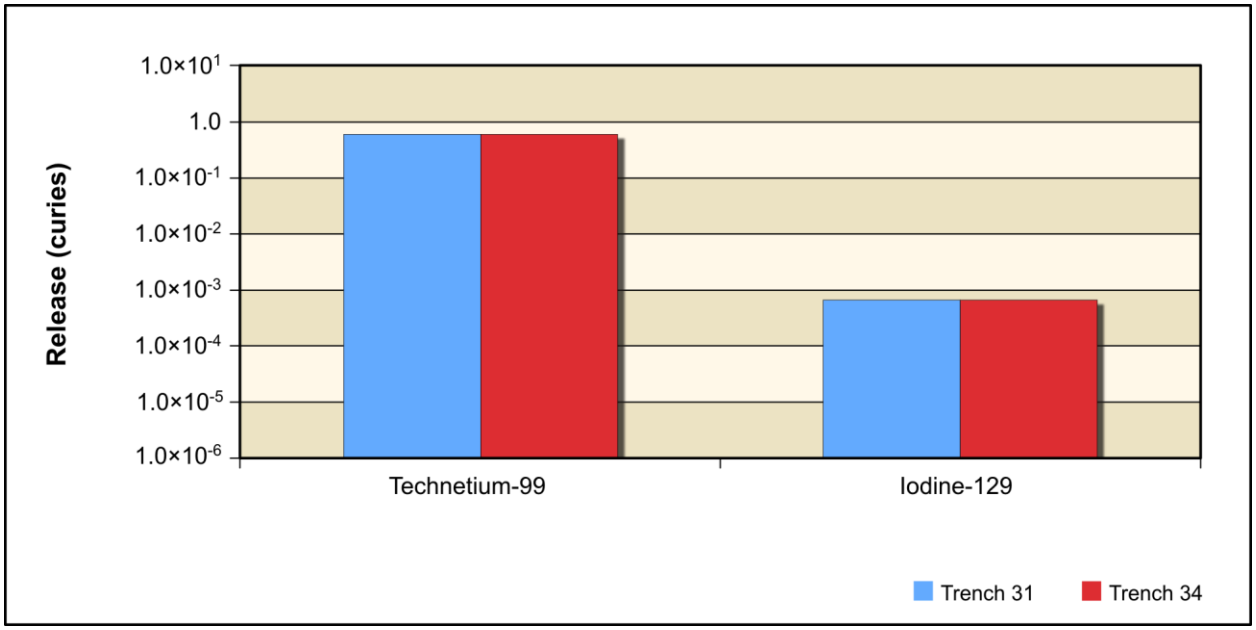


Figure 5–360. Waste Management Alternative 1 Radionuclide Releases from Trenches 31 and 34 to Groundwater

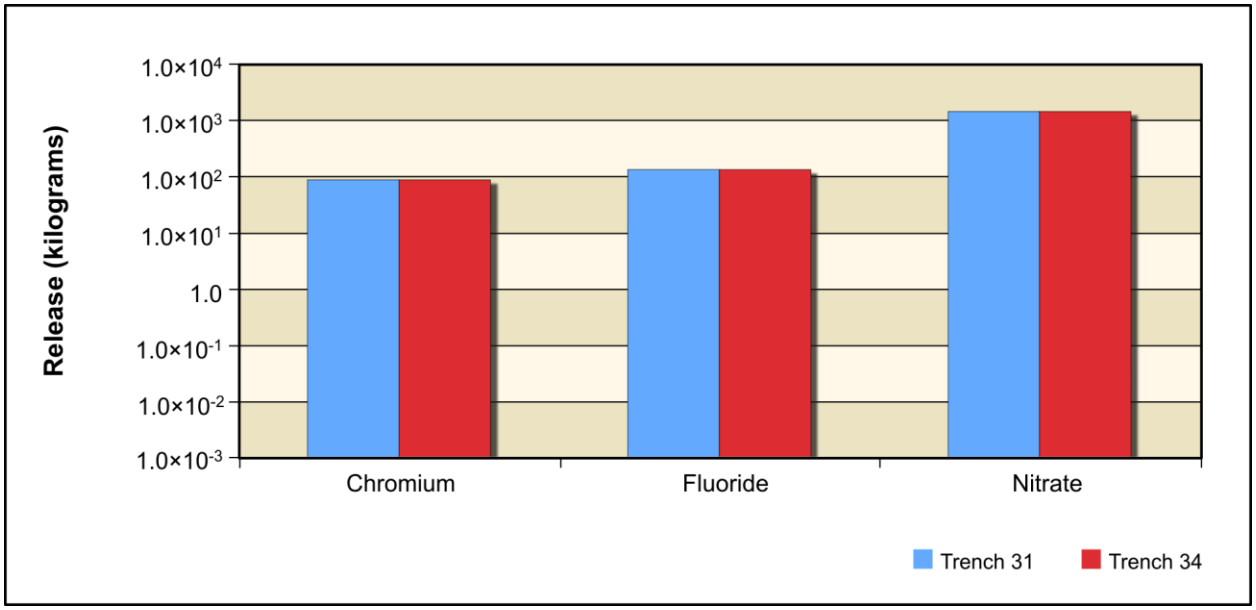


Figure 5–361. Waste Management Alternative 1 Chemical Releases from Trenches 31 and 34 to Groundwater

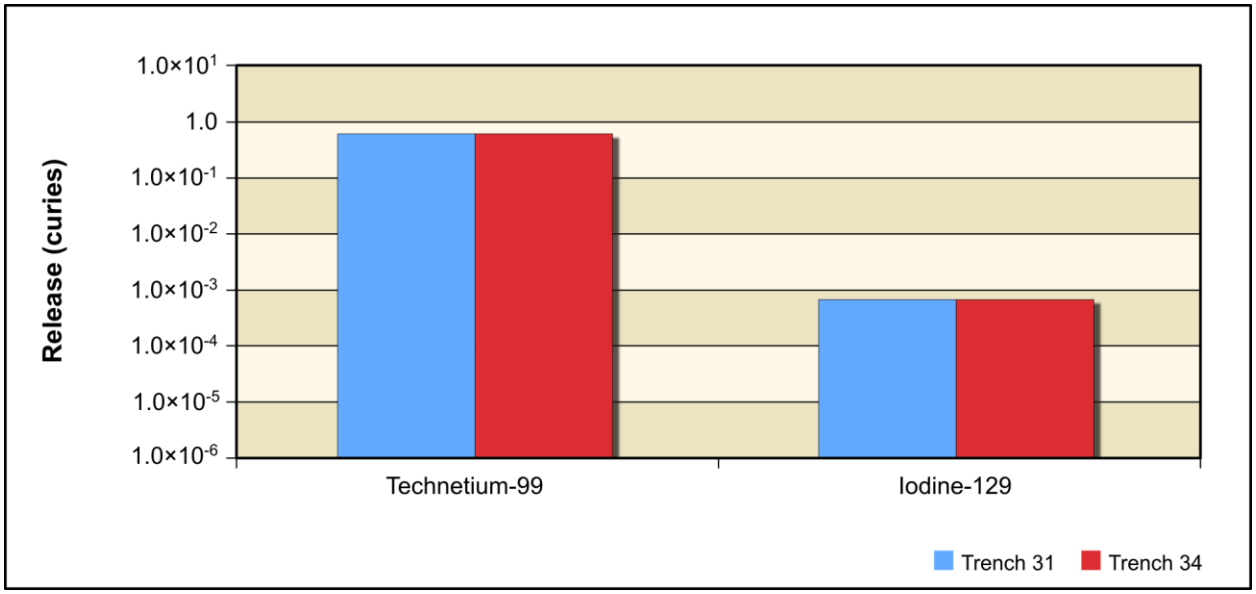


Figure 5–362. Waste Management Alternative 1 Radionuclide Releases from Trenches 31 and 34 to Columbia River

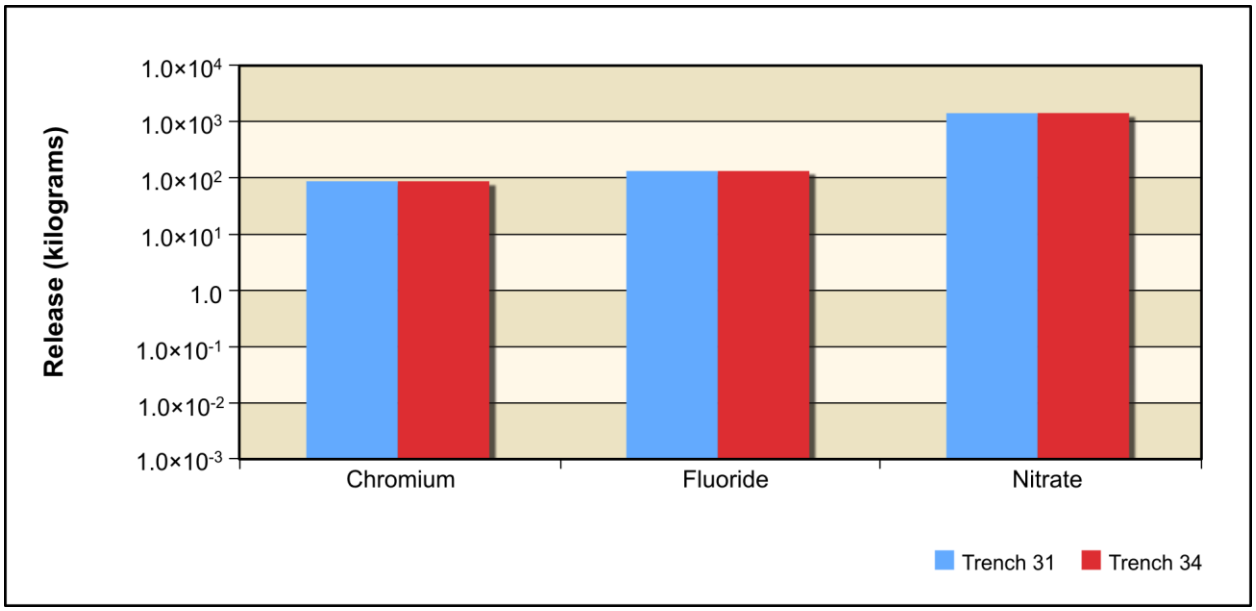


Figure 5–363. Waste Management Alternative 1 Chemical Releases from Trenches 31 and 34 to Columbia River

5.3.1.1.4 Analysis of Concentration Versus Time

This section presents the analysis of Waste Management Alternative 1 impacts in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–364 through 5–368). The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

Table 5–93 lists the maximum concentrations of the COPCs in the peak year at trenches 31 and 34, the Core Zone Boundary, and the Columbia River nearshore. Under Waste Management Alternative 1, no

constituents exceed their benchmark concentrations at trenches 31 and 34, the Core Zone Boundary, or the Columbia River nearshore.

Table 5–93. Waste Management Alternative 1 Maximum COPC Concentrations in the Peak Year at Trenches 31 and 34, the Core Zone Boundary, and the Columbia River Nearshore

Contaminant	Trenches 31 and 34	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)				
Technetium-99	7 (3443)	1 (3462)	1 (3980)	900
Chemical (micrograms per liter)				
Chromium	1 (3490)	0 (3519)	0 (3993)	100
Fluoride	2 (3477)	0 (3530)	0 (3876)	4,000
Nitrate	18 (3514)	1 (3495)	3 (3880)	45,000

Note: Corresponding calendar year shown in parentheses.
Key: COPC=constituent of potential concern.

Figures 5–364 through 5–368 show concentration versus time for iodine-129, technetium-99, chromium, fluoride, and nitrate (the conservative tracers). For technetium-99, concentrations at the Core Zone Boundary rise early in the simulation, reaching a peak of about three orders of magnitude below the benchmark around CY 3940. After this peak, technetium-99 concentrations decline for the remainder of the period of analysis. Iodine-129, chromium, fluoride, and nitrate all follow similar patterns, although the peak concentrations of nitrate and fluoride at the Core Zone Boundary are over four orders of magnitude below the benchmark. Because of retention in the vadose zone and low rate of recharge, fluxes of uranium-238 and total uranium do not reach the aquifer during the 10,000-year period of analysis.

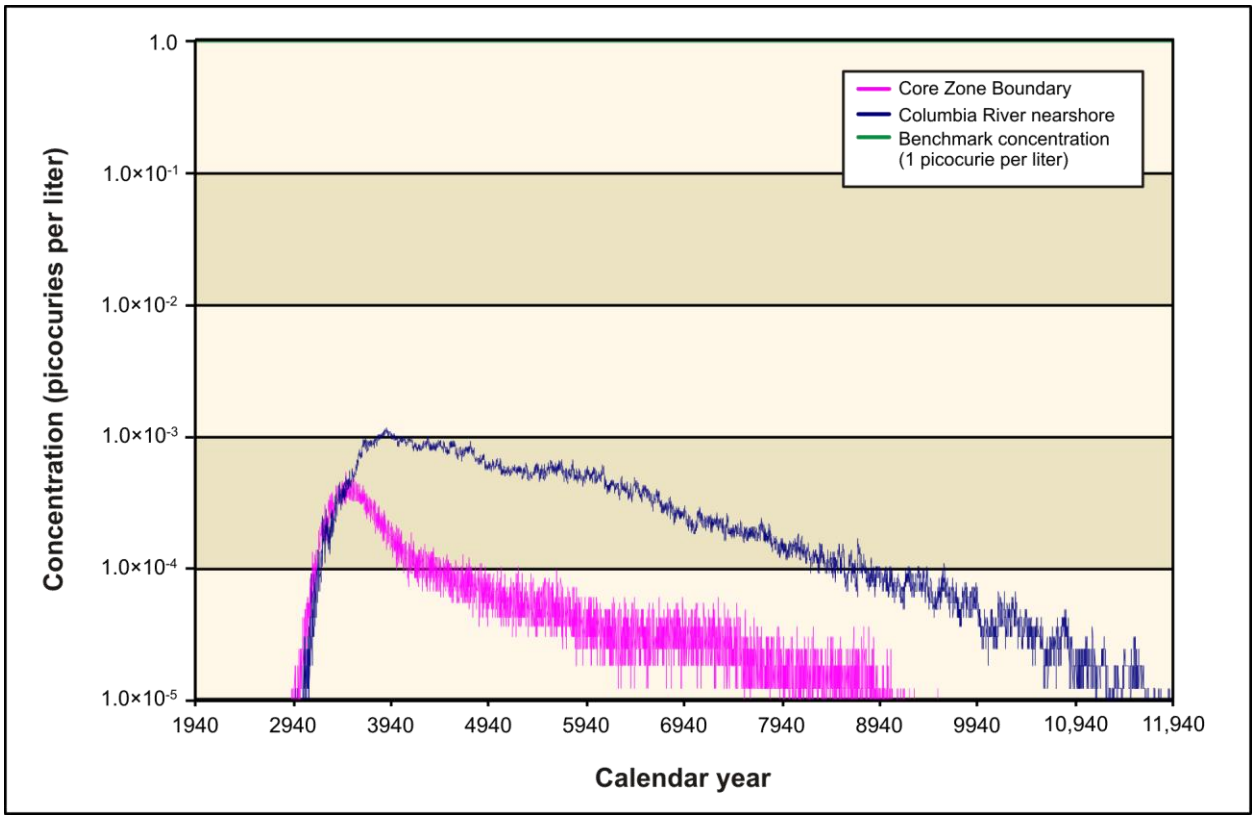


Figure 5–364. Waste Management Alternative 1 Iodine-129 Concentration Versus Time

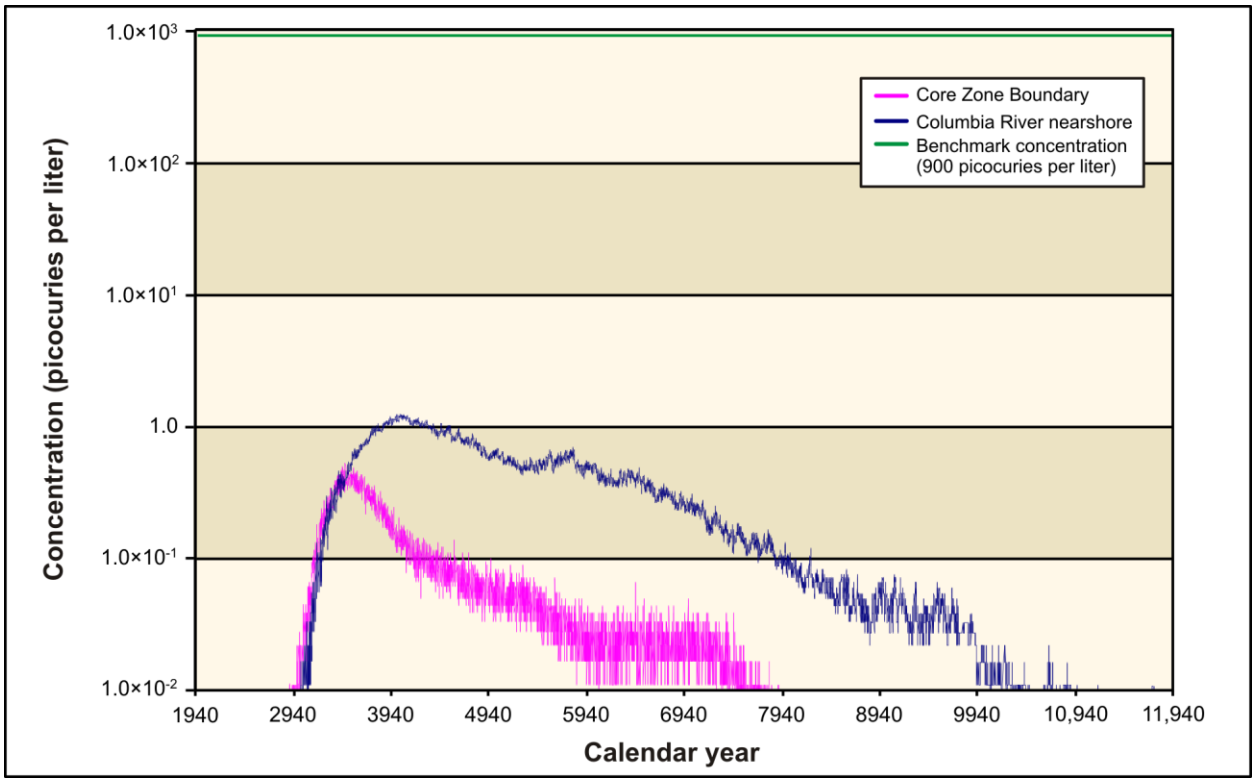


Figure 5–365. Waste Management Alternative 1 Technetium-99 Concentration Versus Time

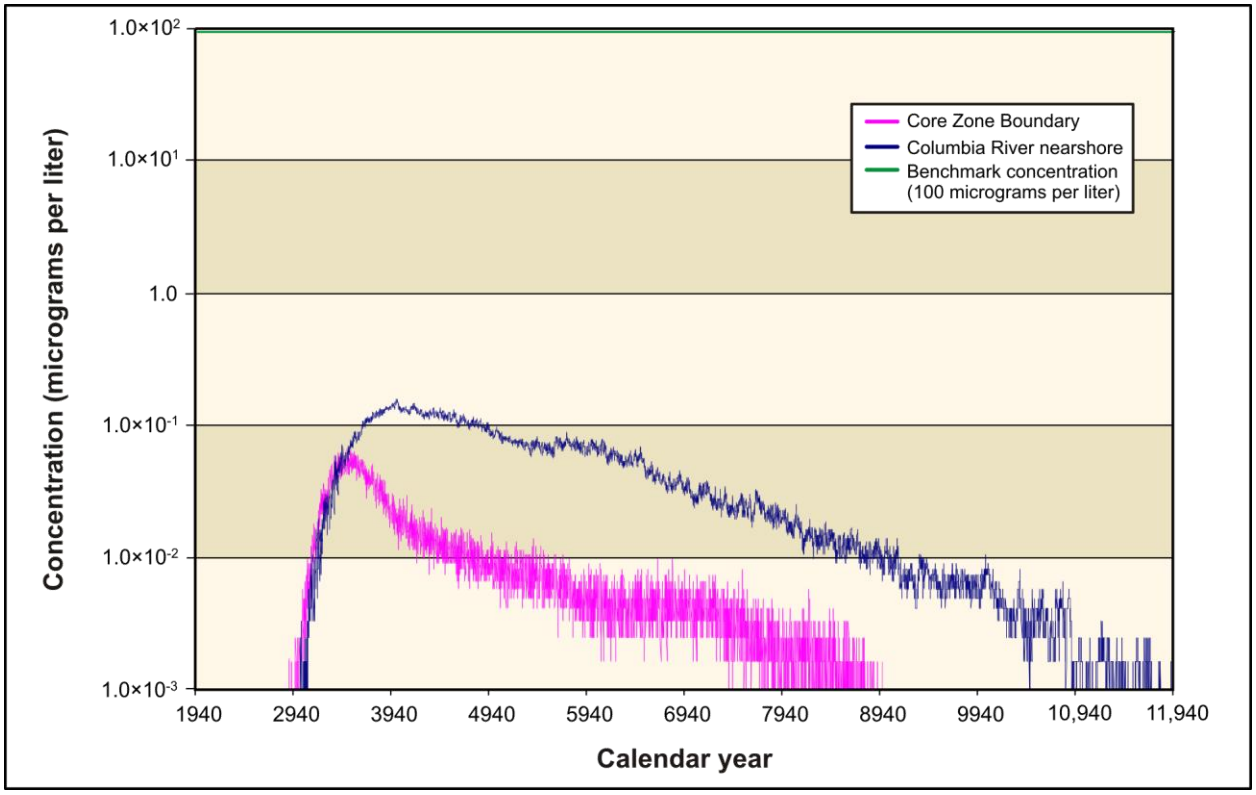


Figure 5–366. Waste Management Alternative 1 Chromium Concentration Versus Time

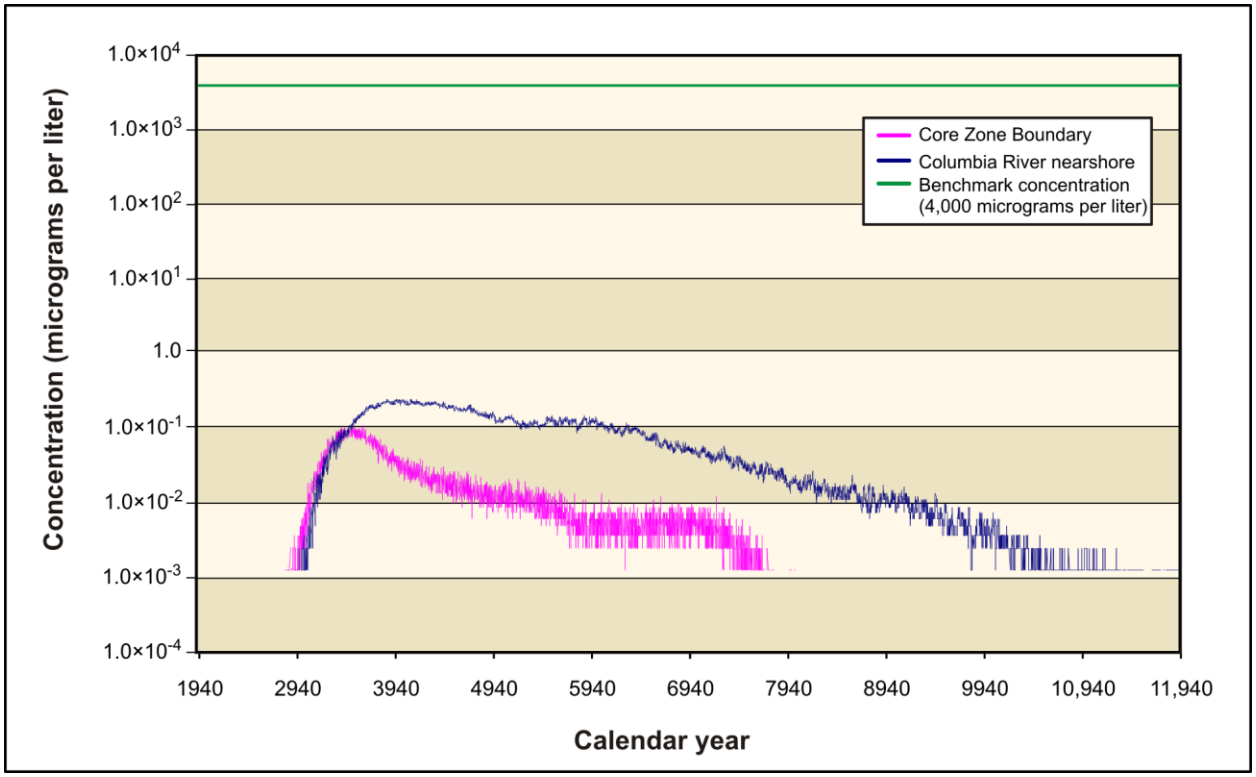


Figure 5–367. Waste Management Alternative 1 Fluoride Concentration Versus Time

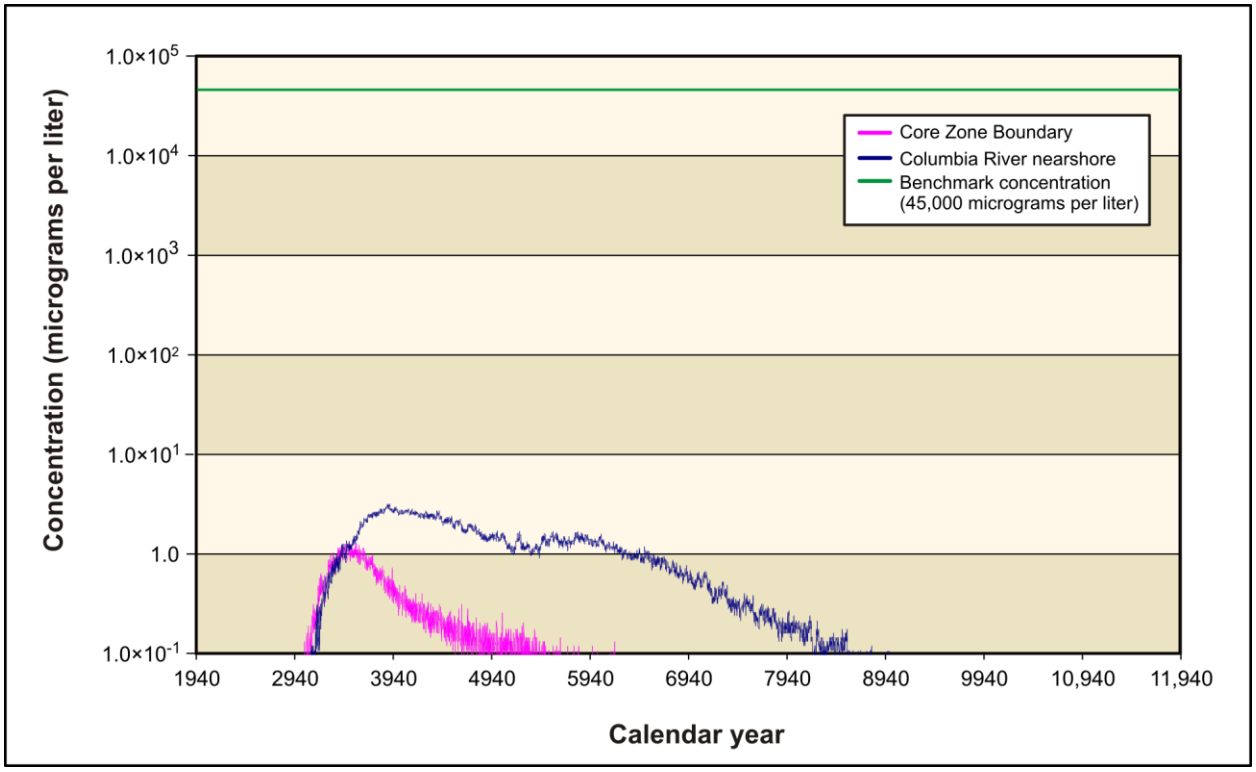
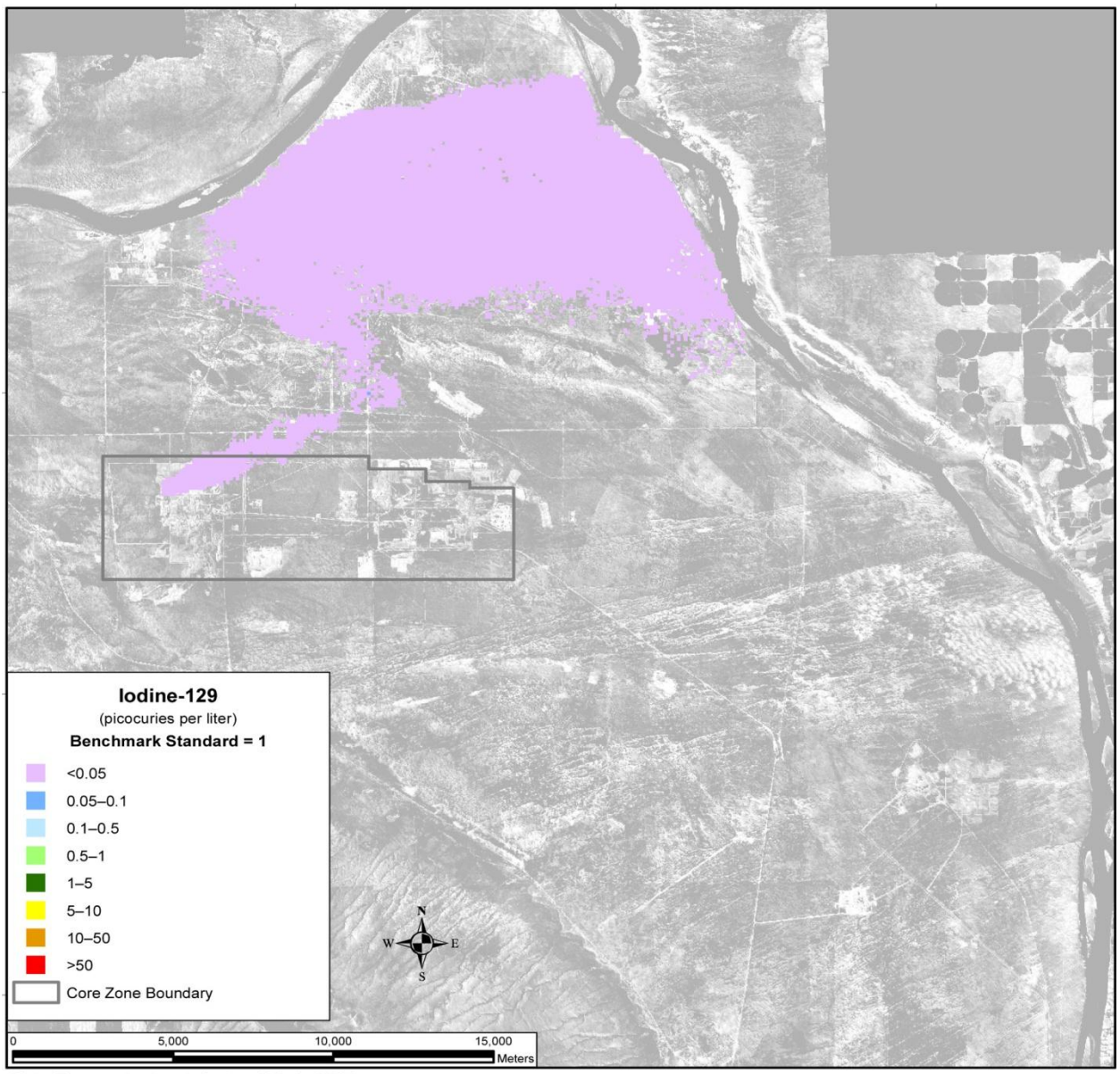


Figure 5–368. Waste Management Alternative 1 Nitrate Concentration Versus Time

5.3.1.1.5 Analysis of Spatial Distribution of Concentration

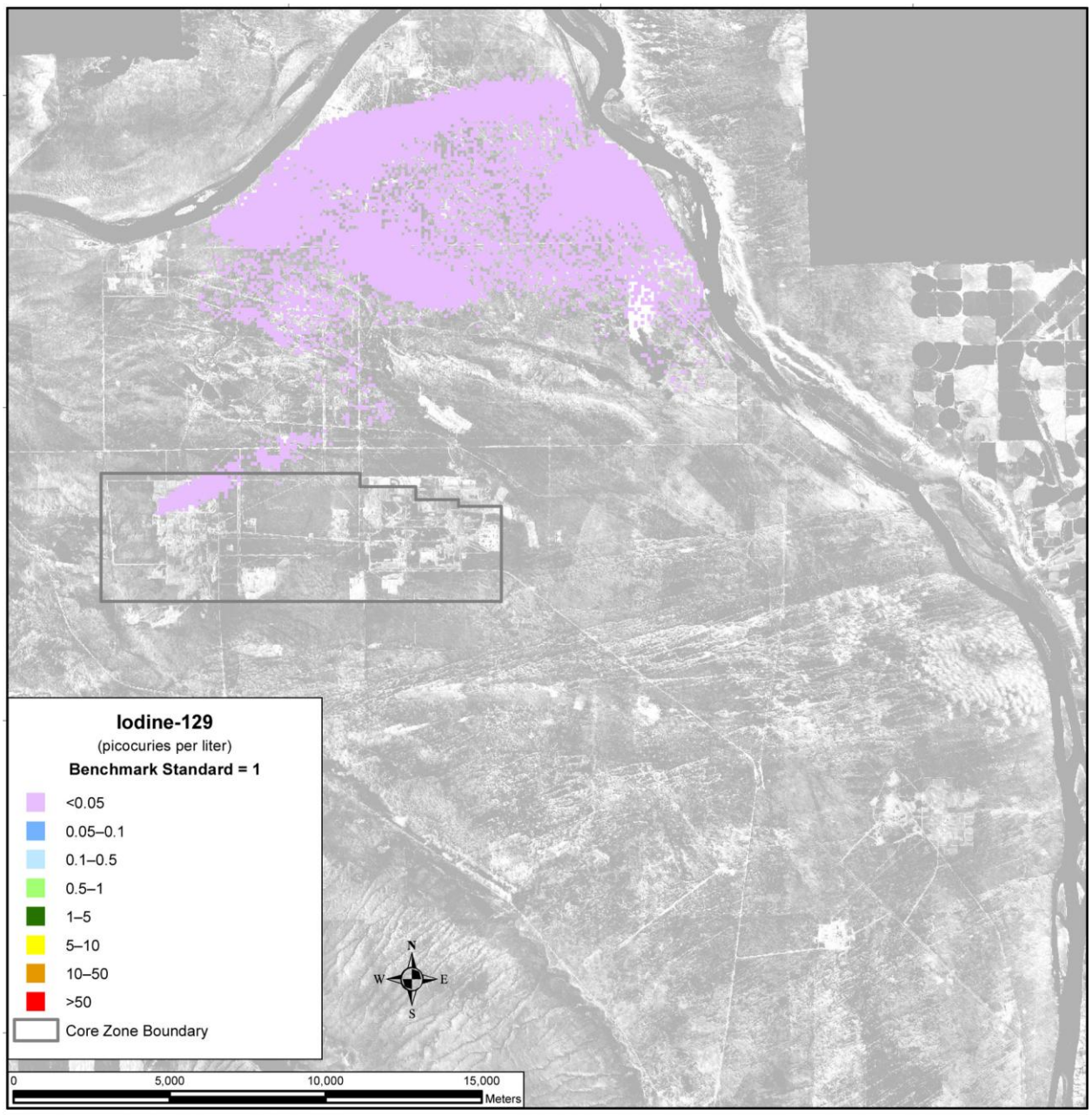
This section presents the impacts of Waste Management Alternative 1 in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–369 through 5–380). Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

In CY 3890 (see Figure 5–369), there is a very low-concentration (less than one-twentieth of the benchmark) plume of iodine-129 stretching northeast of trenches 31 and 34 and through Gable Gap. By CY 7140 (see Figure 5–370), the plume has significantly dissipated. By CY 11,885 (see Figure 5–371), the plume has almost completely dissipated. Technetium-99 (see Figures 5–372 through 5–374), nitrate (see Figures 5–375 through 5–377), and chromium (see Figures 5–378 through 5–380) show similar spatial distributions at selected times. Iodine-129, technetium-99, nitrate, and chromium are all conservative tracers (i.e., move at the rate of the pore-water velocity).



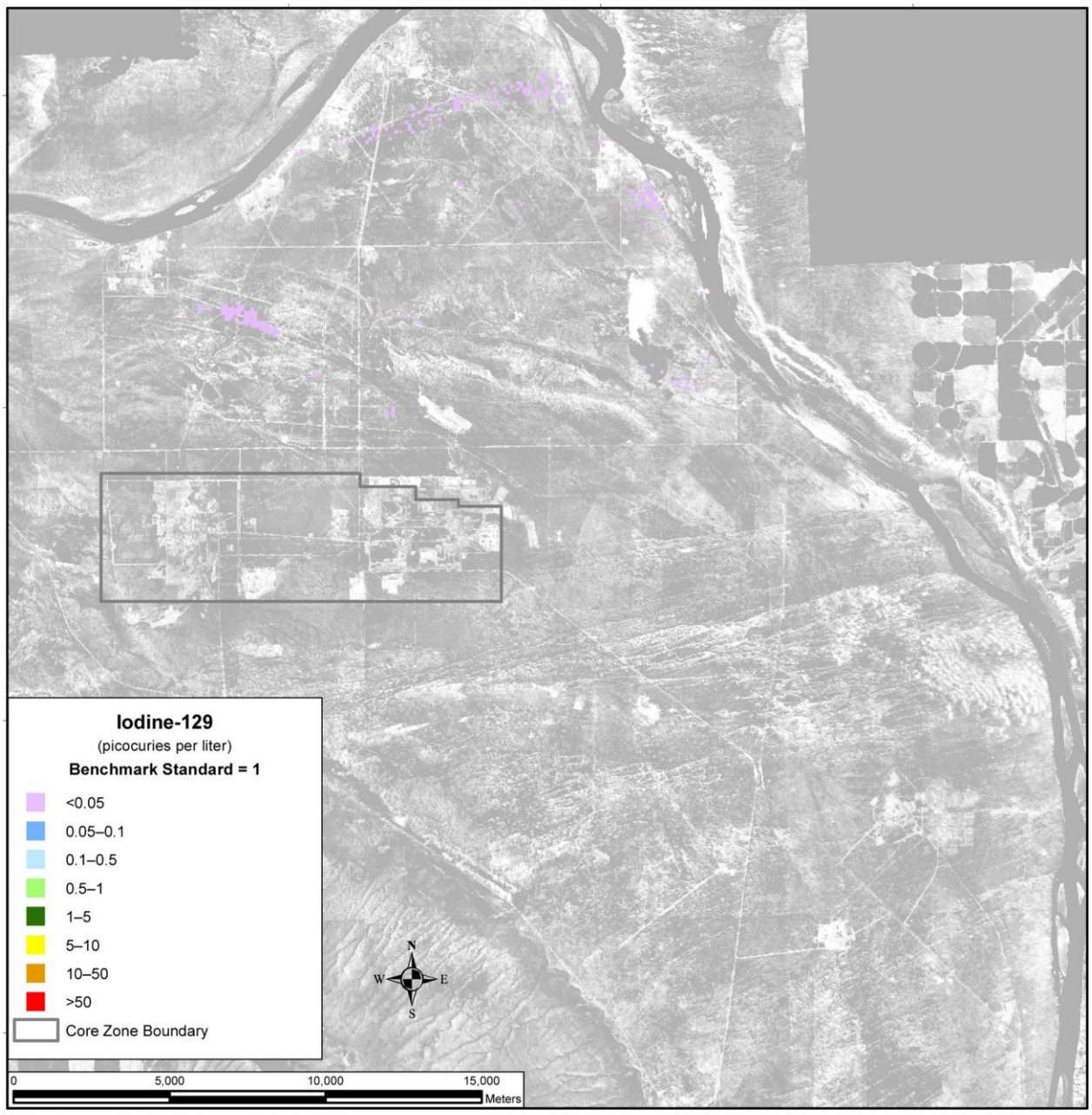
Note: To convert meters to feet, multiply by 3.281.

Figure 5–369. Waste Management Alternative 1 Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



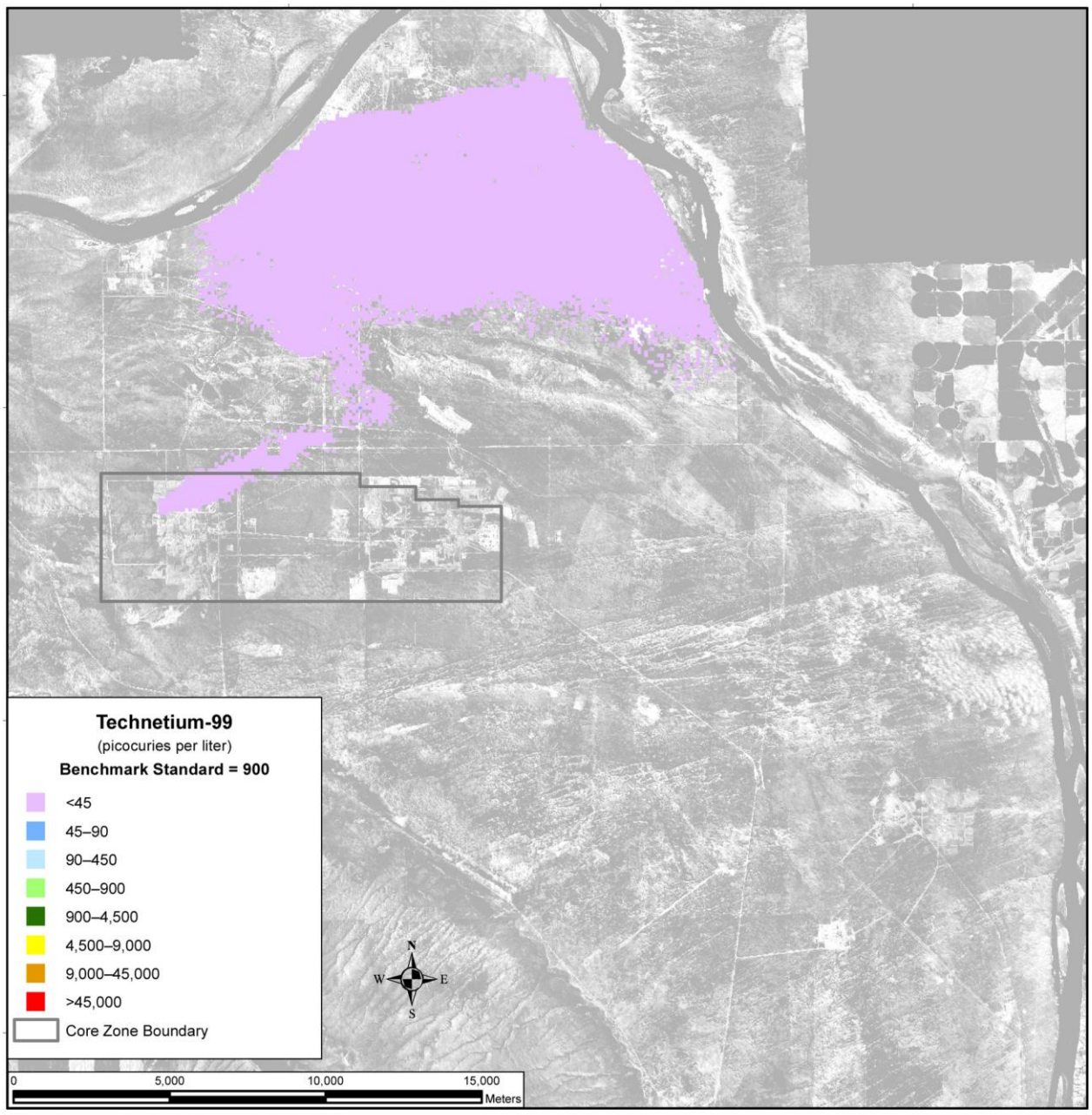
Note: To convert meters to feet, multiply by 3.281.

Figure 5–370. Waste Management Alternative 1, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



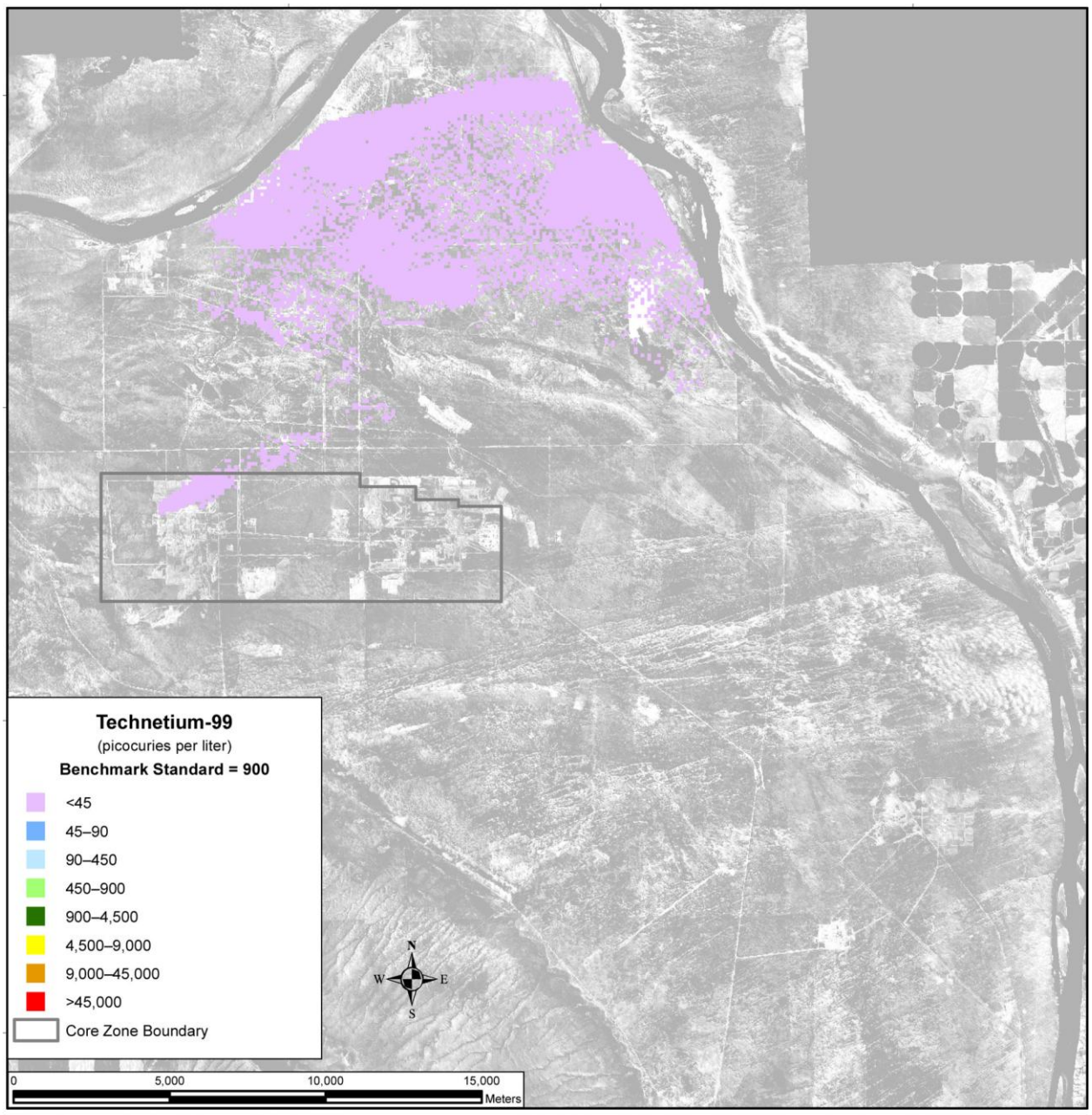
Note: To convert meters to feet, multiply by 3.281.

Figure 5–371. Waste Management Alternative 1 Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



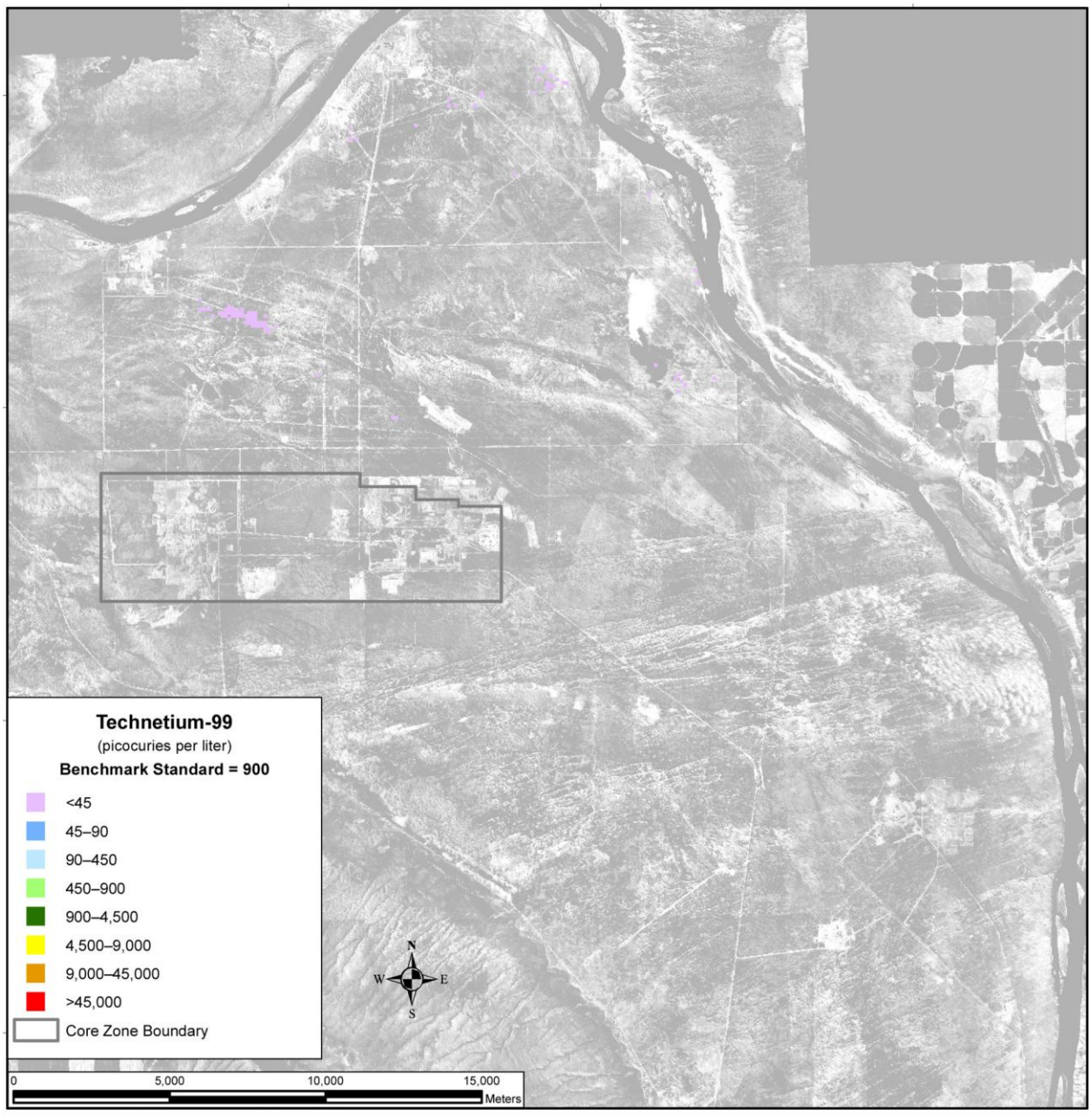
Note: To convert meters to feet, multiply by 3.281.

Figure 5–372. Waste Management Alternative 1 Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



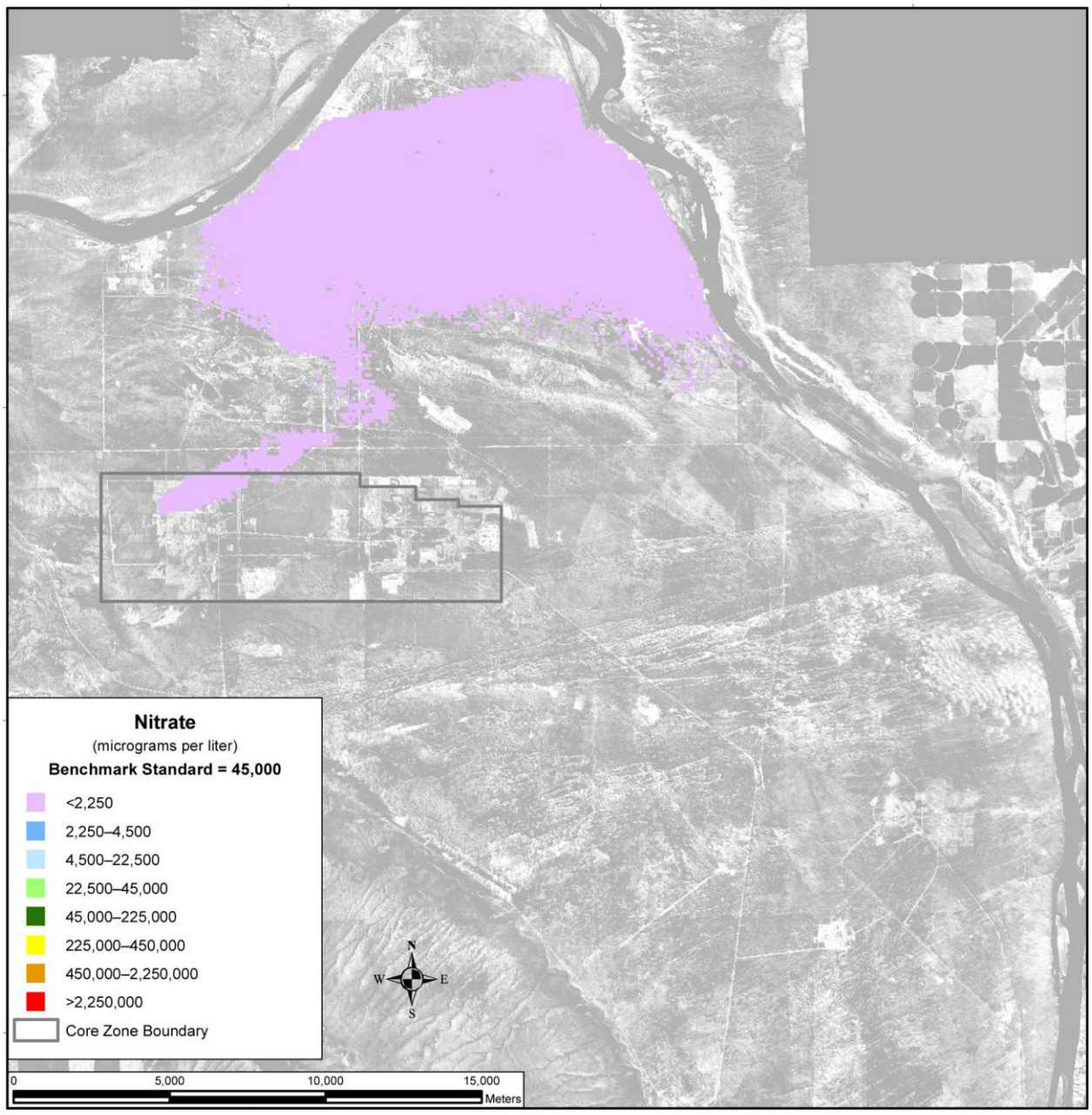
Note: To convert meters to feet, multiply by 3.281.

Figure 5–373. Waste Management Alternative 1 Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



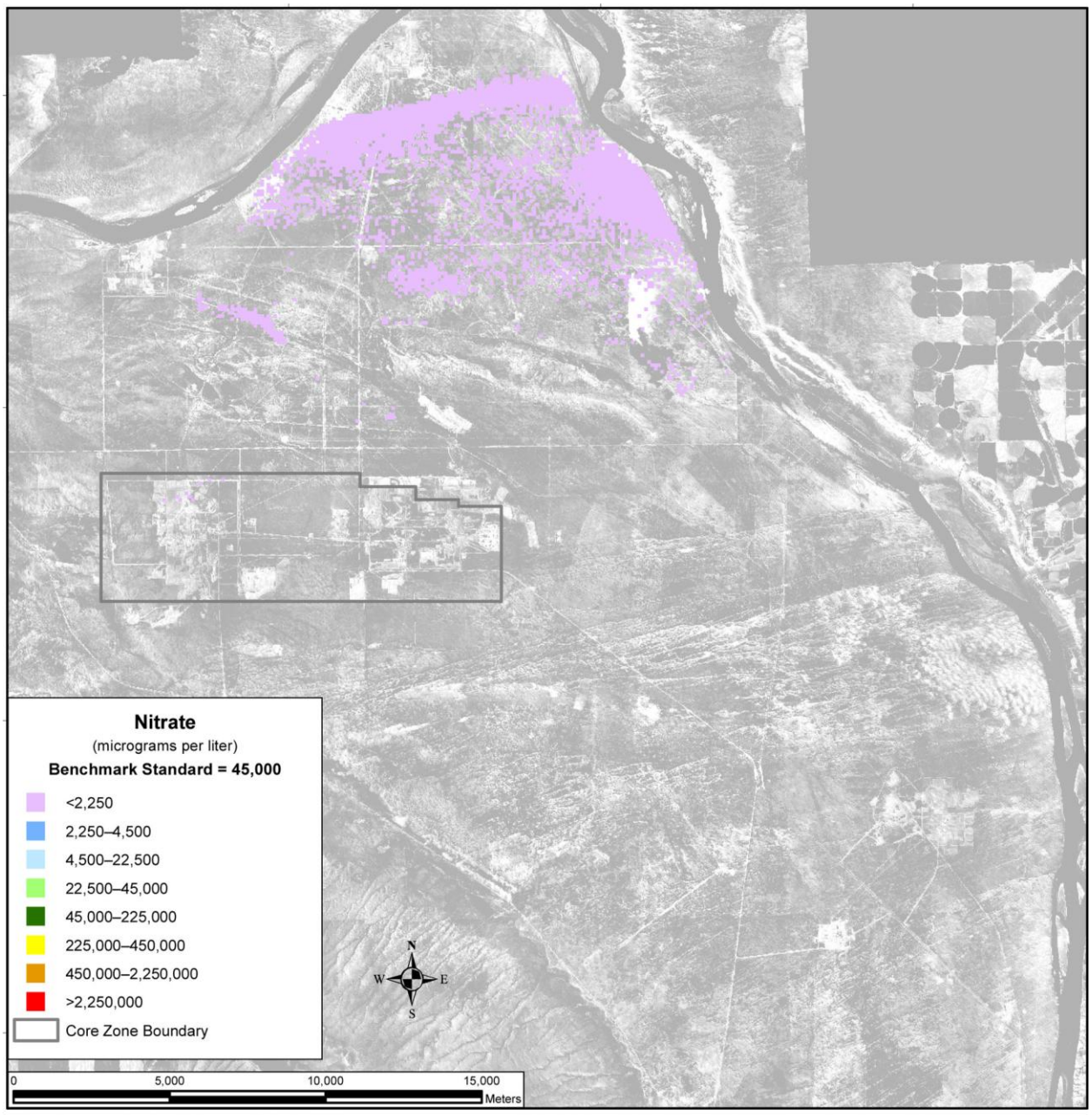
Note: To convert meters to feet, multiply by 3.281.

Figure 5–374. Waste Management Alternative 1 Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



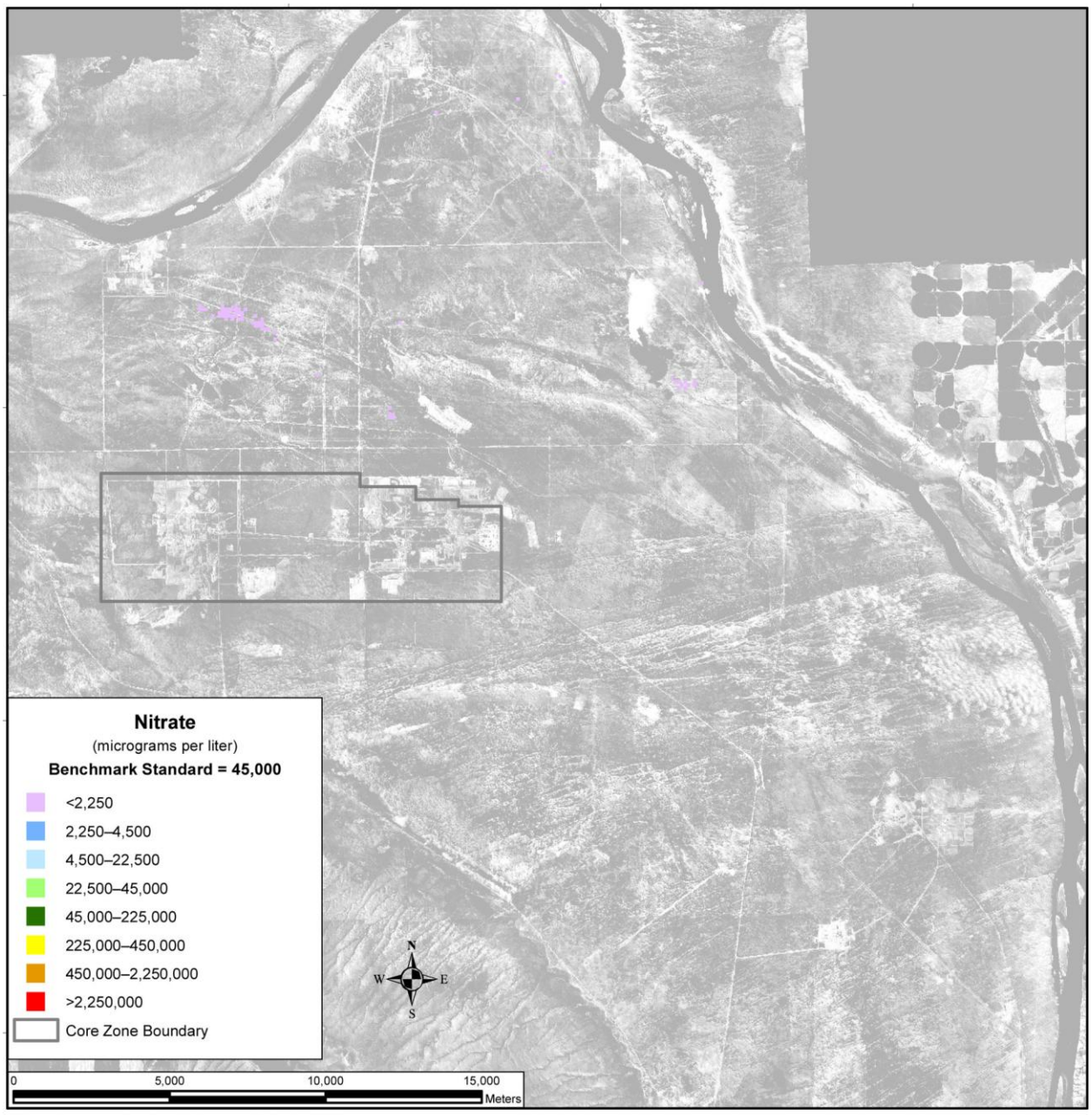
Note: To convert meters to feet, multiply by 3.281.

Figure 5–375. Waste Management Alternative 1 Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



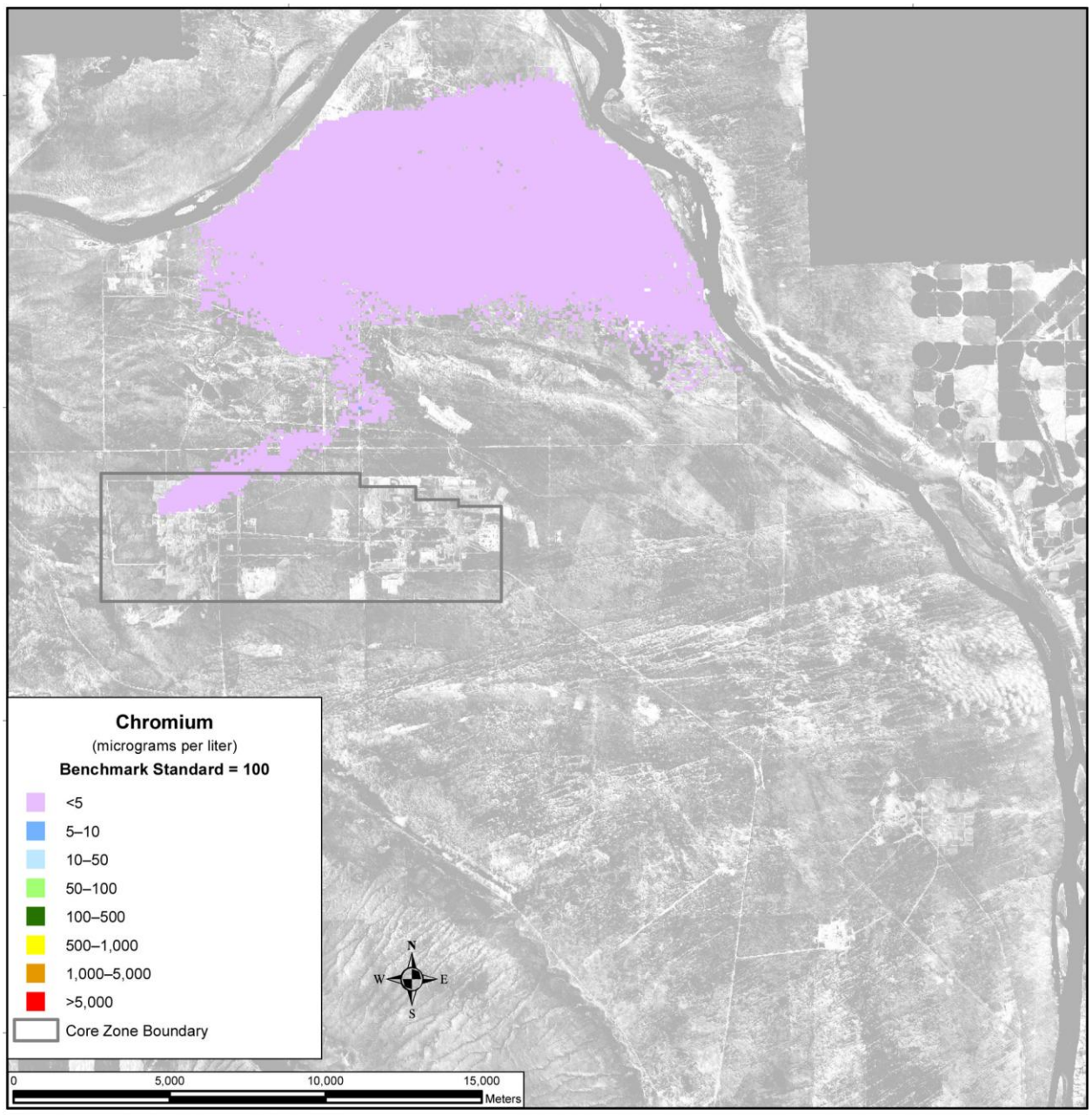
Note: To convert meters to feet, multiply by 3.281.

Figure 5–376. Waste Management Alternative 1 Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



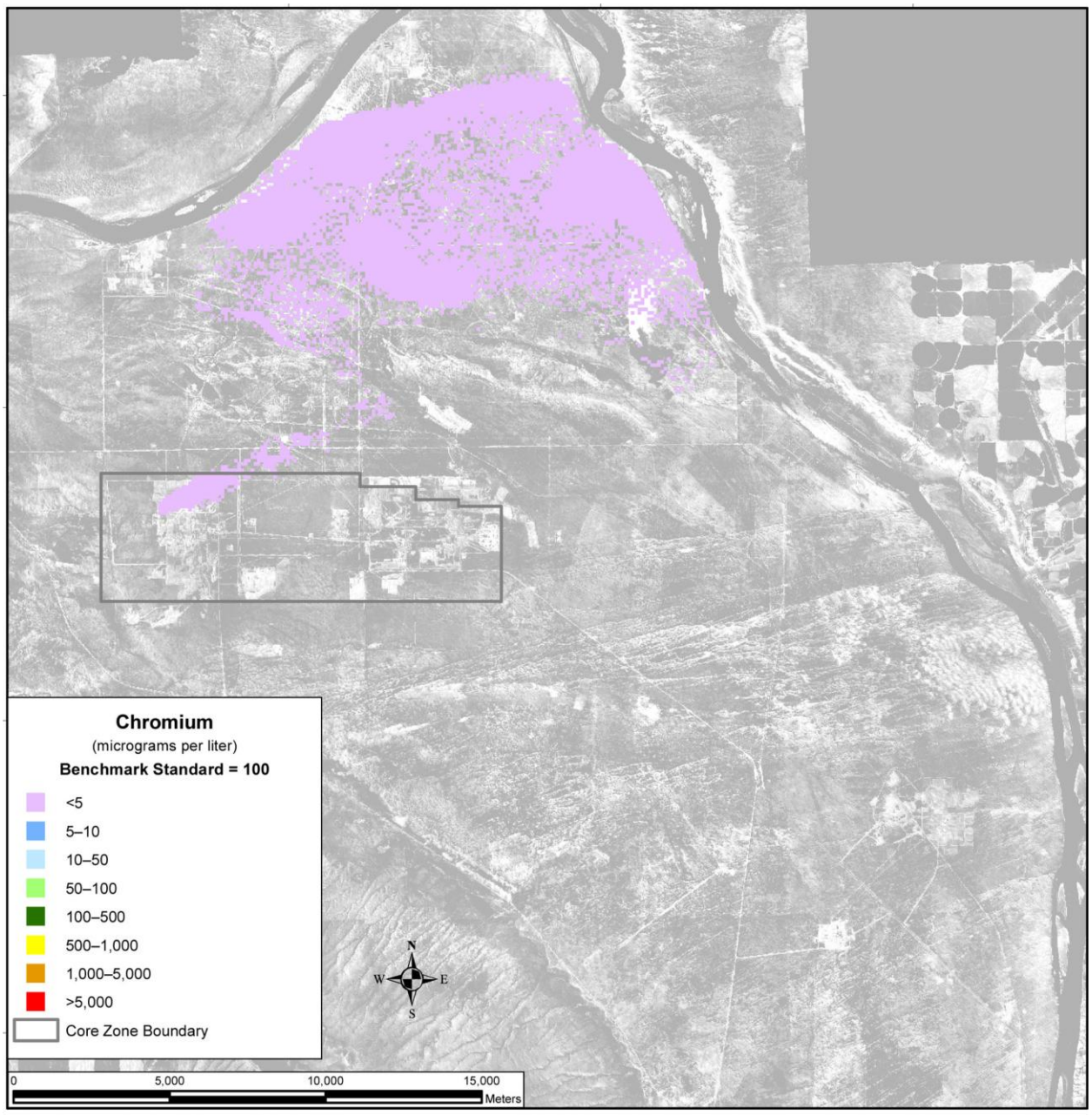
Note: To convert meters to feet, multiply by 3.281.

Figure 5–377. Waste Management Alternative 1 Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885



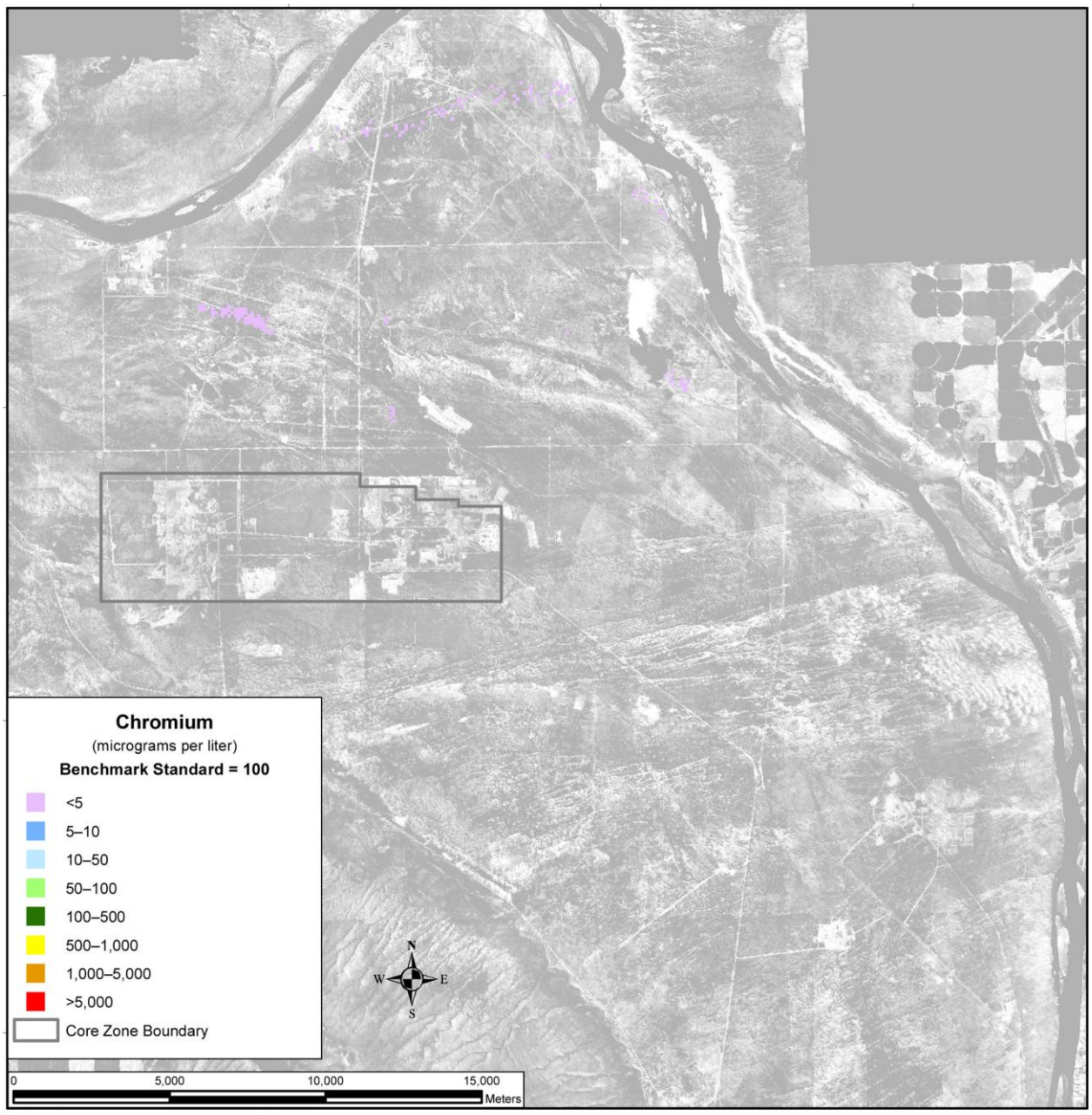
Note: To convert meters to feet, multiply by 3.281.

Figure 5–378. Waste Management Alternative 1 Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–379. Waste Management Alternative 1 Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–380. Waste Management Alternative 1 Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885

5.3.1.1.6 Summary of Impacts

Under Waste Management Alternative 1, all discharges originate in trenches 31 and 34.

No COPCs reach a concentration exceeding the benchmark concentration at the barriers of trenches 31 and 34, the Core Zone Boundary, or the Columbia River nearshore during the course of the simulation.

5.3.1.2 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only

This section describes the groundwater analysis results for Waste Management Alternative 2, including long-term groundwater impacts of contaminant sources within the IDF-East and RPPDF barriers. Impacts of sources remaining within the tank farm barriers are presented in Section 5.1, which discusses tank closure impacts. Impacts of sources remaining within the FFTF barrier are presented in Section 5.2, which discusses FFTF decommissioning impacts.

Summaries of the proposed actions and timelines for Waste Management Alternative 2 are provided in Chapter 2, Section 2.5. There are three disposal facilities, as follows:

- LLBG 218-W-5, trenches 31 and 34, which receive LLW and MLLW. For analysis purposes, the waste inventories associated with these trenches are included in the IDF-East inventory.

- IDF-East, located in the south-central part of the 200-East Area, which receives tank waste, FFTF decommissioning waste, onsite non-CERCLA waste, and offsite LLW and MLLW. The LLW and MLLW inventories for trenches 31 and 34 are also included in the IDF-East inventory in this analysis.

- The RPPDF, located in the Core Zone between the 200-East and 200-West Areas, which receives lightly contaminated equipment and soils resulting from tank farm closure activities.

Three disposal groups were analyzed. Each has a different configuration and timeline for IDF-East and the RPPDF. The three disposal groups are discussed in detail in the following subsections.

5.3.1.2.1 Disposal Group 1

Disposal Group 1 is characterized by an operational completion date of CY 2050 for both IDF-East and the RPPDF. Under Disposal Group 1, IDF-East would have a large capacity (1,200,000 cubic meters [1,570,000 cubic yards]) and the RPPDF, a smaller capacity (1,030,000 cubic meters [1,350,000 cubic yards]). These capacities were designed to meet the waste generation volumes associated with Tank Closure Alternative 2B, 3A, 3B, 3C, 4, 5, or 6C; FFTF Decommissioning Alternative 2 or 3; and waste management activities.

5.3.1.2.1.1 Disposal Group 1, Subgroup 1-A

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Disposal Group 1, Subgroup 1-A, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 2B and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Waste would be converted to IHLW and ILAW glass. IHLW would be stored on site, while ILAW glass would be disposed of in IDF-East.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and the RPPDF in CY 2008 and continue through CY 2050, when these facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in the facilities would

become available for release to the environment, and modified RCRA Subtitle C barriers would be emplaced over IDF-East and the RPPDF to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 2. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A (Tank Closure Alternative 2B, FFTF Decommissioning Alternative 3, and onsite and offsite waste), is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, in terms of the total amount of COPCs released to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms (see Figures 5–381 through 5–392). Seven subtotals are plotted, representing releases from IDF-East and the RPPDF, which include ILAW glass, Effluent Treatment Facility (ETF)–generated secondary waste, retired melters, tank closure secondary waste, FFTF Decommissioning Alternative 3 waste, waste management secondary waste, and onsite and offsite waste. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over more than 10 orders of magnitude within the same series of figures.

Figure 5–381 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers, representing the individual waste form release, and Figure 5–382, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period in the analysis). For the radioactive COPCs (technetium-99 and iodine-129), the releases range over seven orders of magnitude, depending on the source. The chemical COPCs (chromium, fluoride, and nitrate) released from IDF-East derive from waste management secondary and onsite waste. Other sources include 99 percent of the nitrate release from ETF-generated secondary waste and 81 percent of the chromium release from tank closure secondary waste; the other chromium releases are dispersed in the other waste forms.

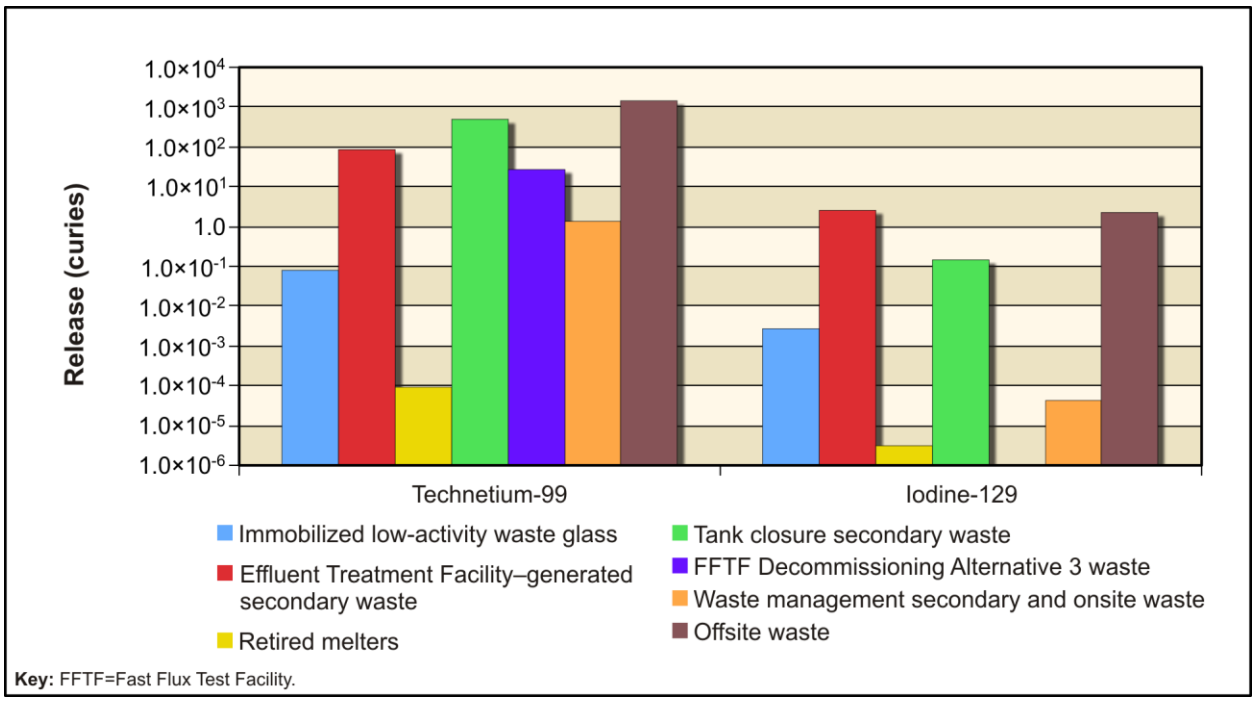


Figure 5–381. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

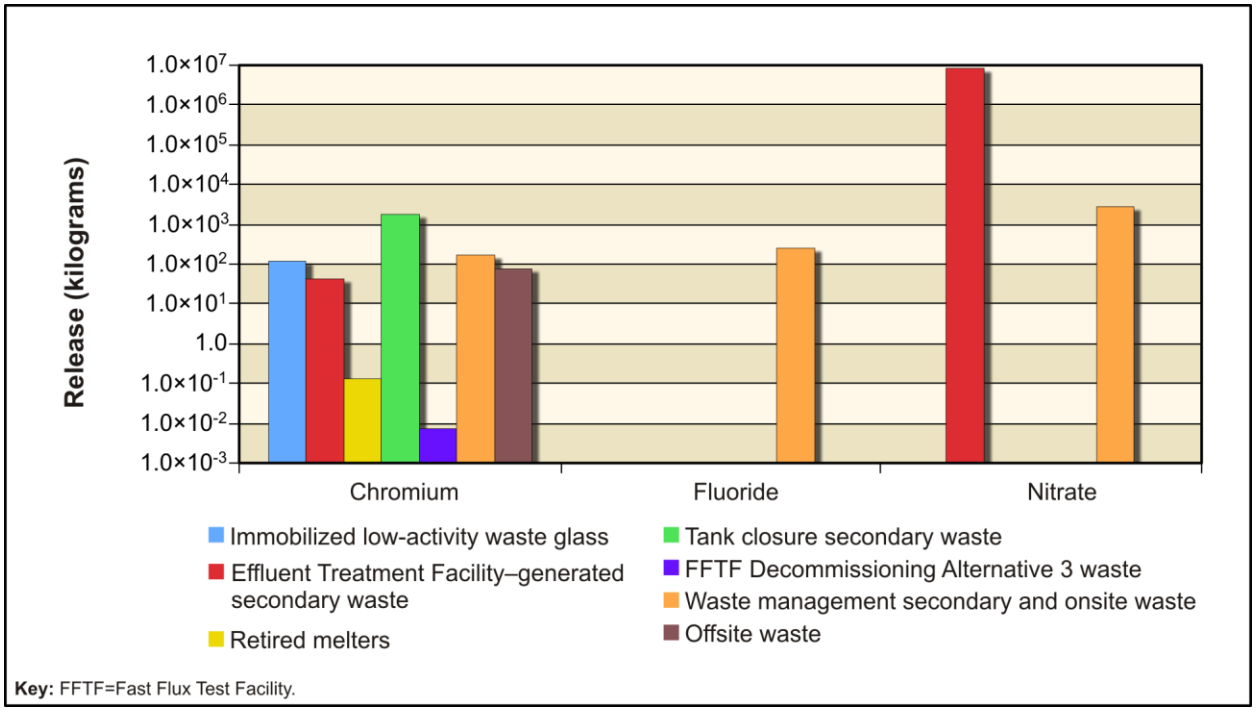


Figure 5–382. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–383 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–384, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For the conservative tracers

(iodine-129, technetium-99, boron, chromium, fluoride, and nitrate), the amount released to groundwater is essentially equal to the amount released to the vadose zone. The exception to this is the release associated with retired melters. The release rates from retired melters are low, and transport times through the vadose zone are long in dry conditions applicable to IDF-East. These factors limit the amount of mass transported to the Columbia River during the 10,000-year period of analysis.

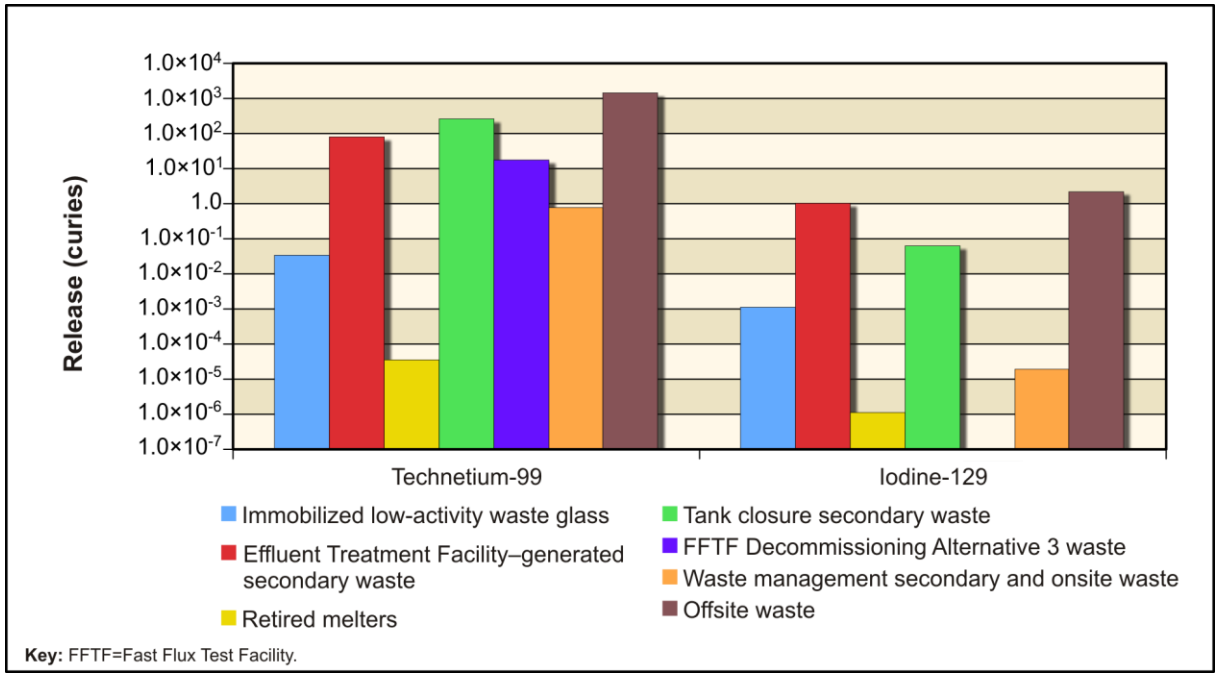


Figure 5–383. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

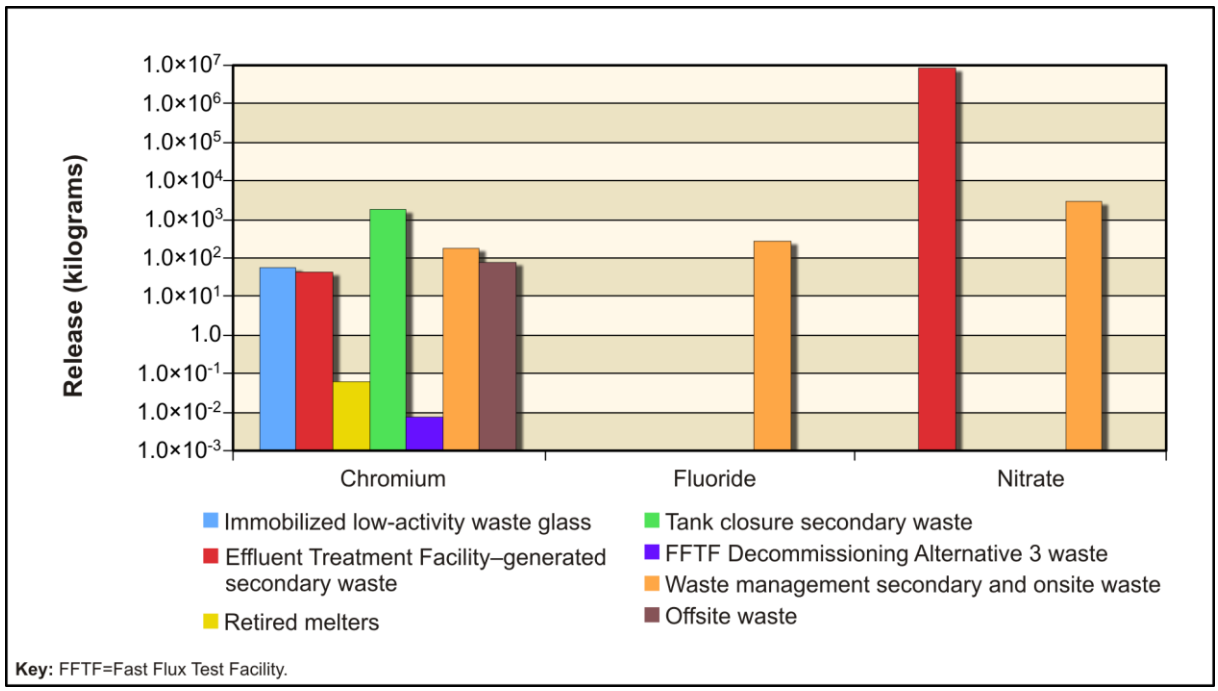


Figure 5–384. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–385 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–386, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For the conservative tracers (iodine-129, technetium-99, chromium, fluoride, and nitrate), the amount released to the Columbia River is essentially equal to the amount released to groundwater. The exception to this is the *de minimis* release associated with the retired melters; the release rates are so small from retired melters that only negligible amounts leave the vadose zone during the 10,000-year period of analysis.

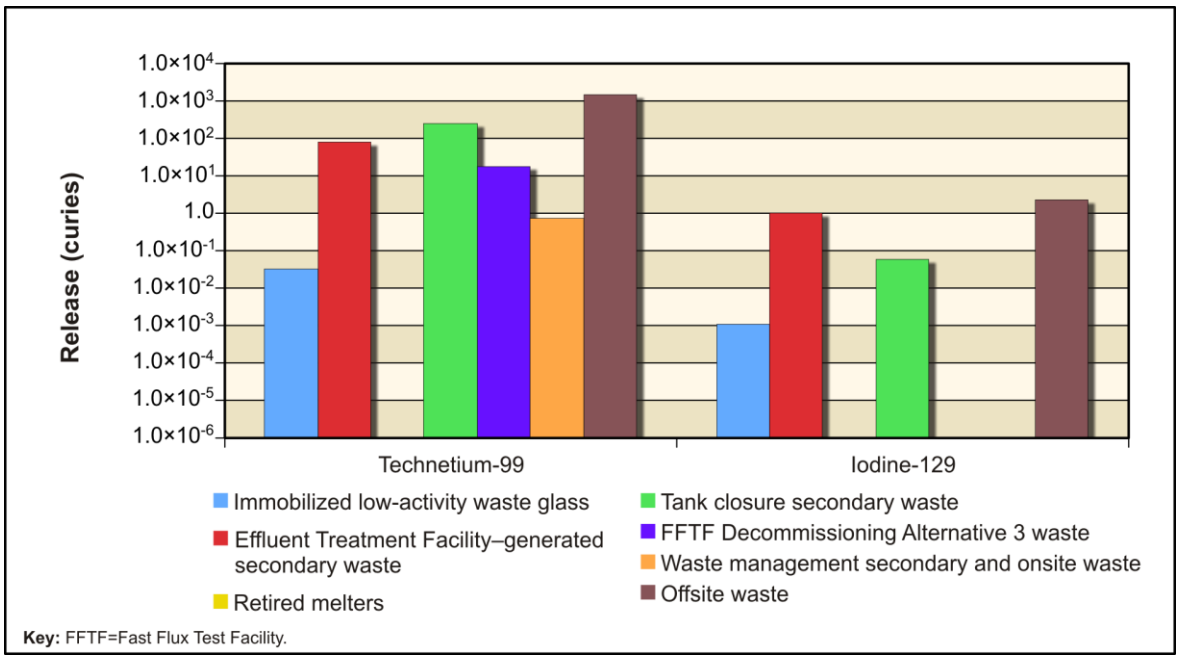


Figure 5–385. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

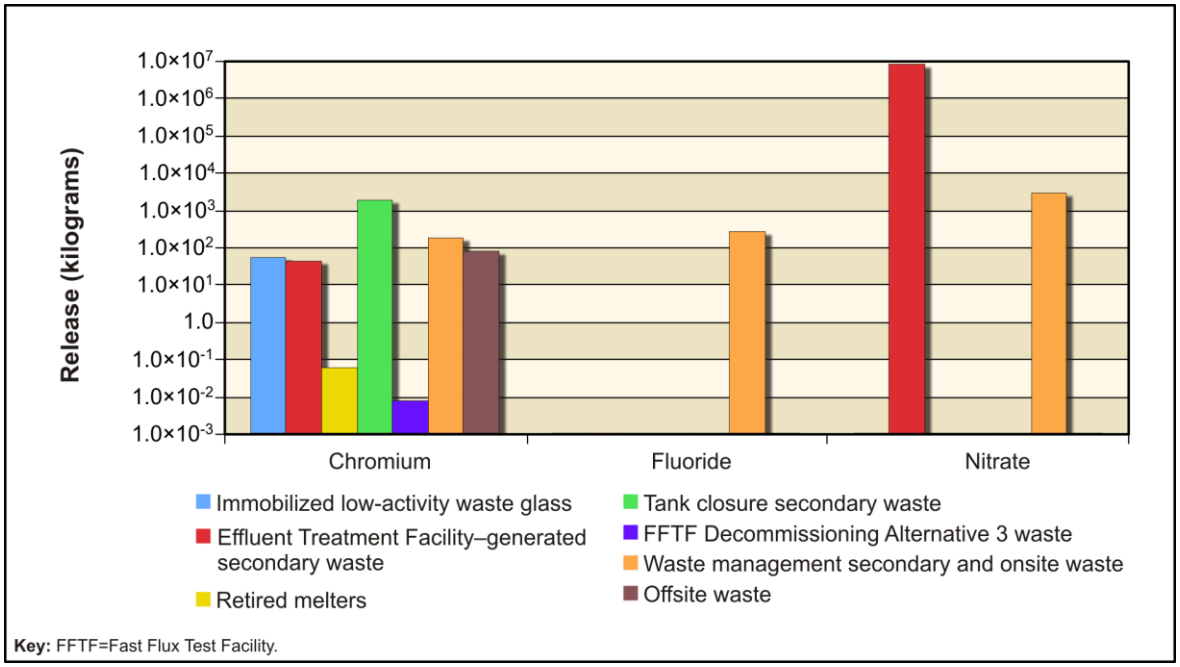


Figure 5–386. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

Figure 5–387 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–388, the chemical hazard drivers. The release of technetium-99 is more than two orders of magnitude greater than the release of iodine-129 from the RPPDF. The chemical constituents show nitrate as the predominant COPC, about two orders of magnitude greater than the release of chromium at the RPPDF.

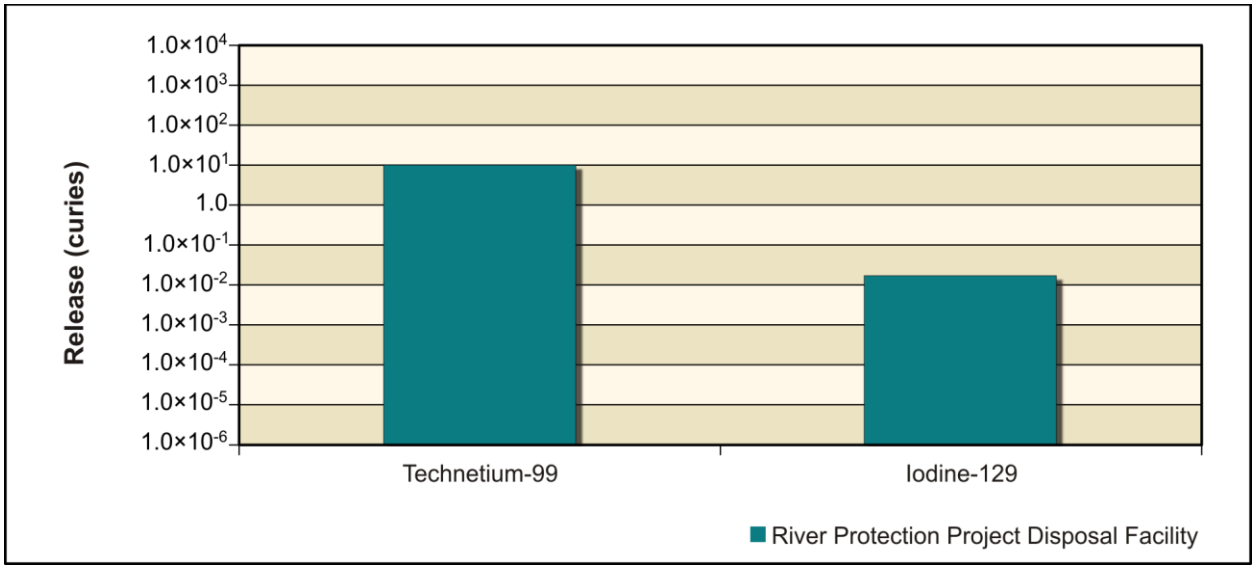


Figure 5–387. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

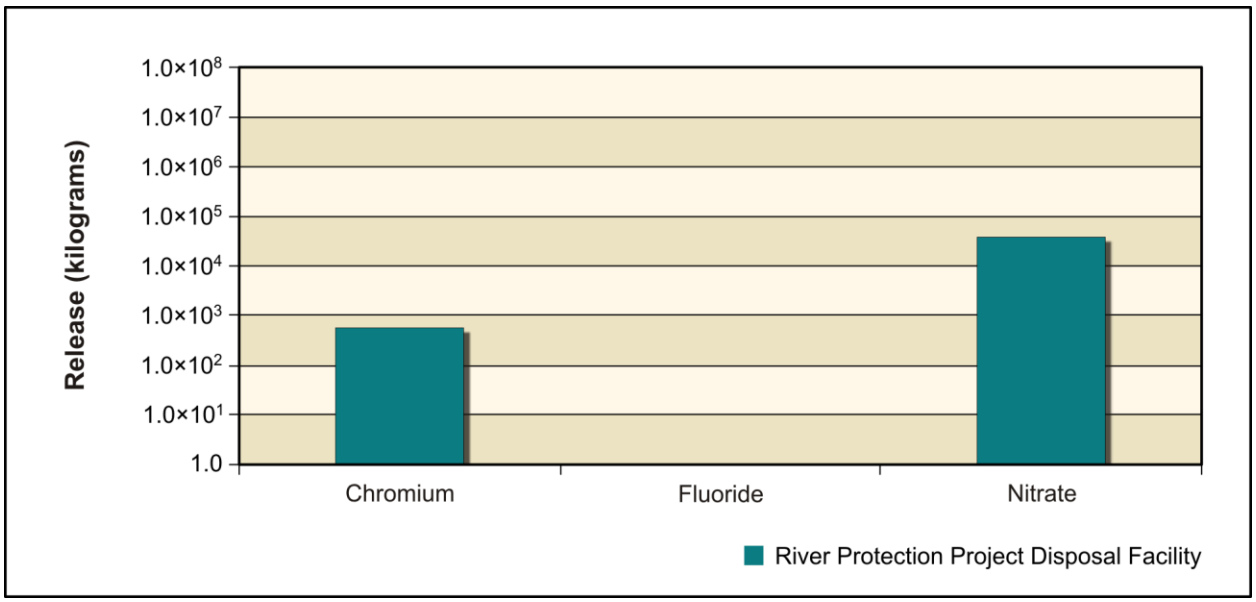


Figure 5–388. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–389 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–390, the chemical hazard drivers. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to groundwater is essentially equal to the amount released to the vadose zone.

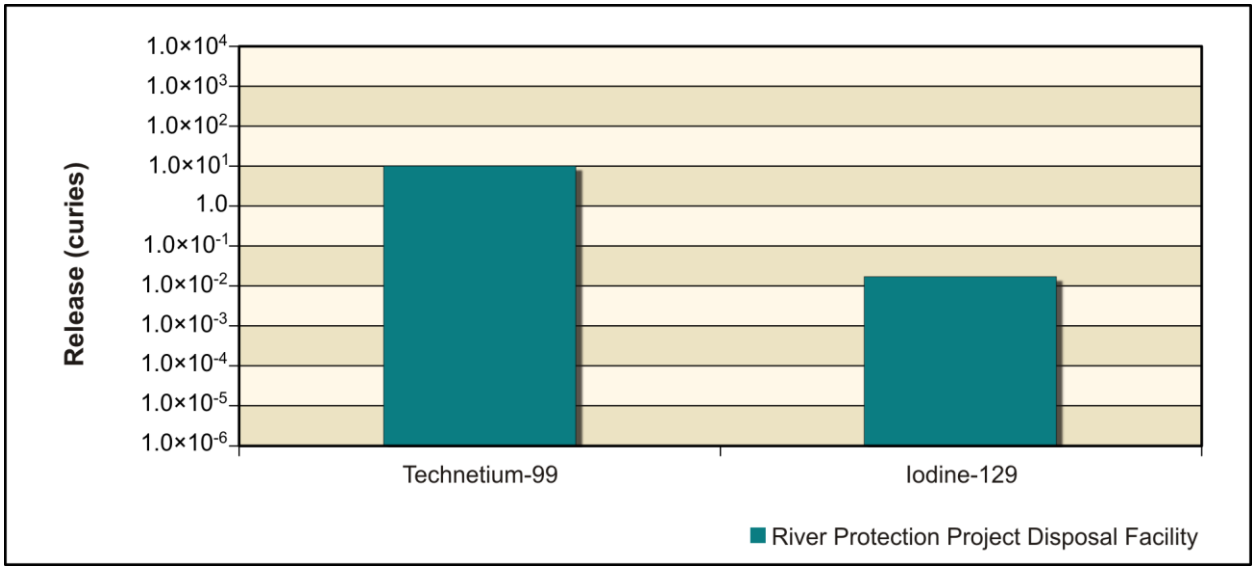


Figure 5–389. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

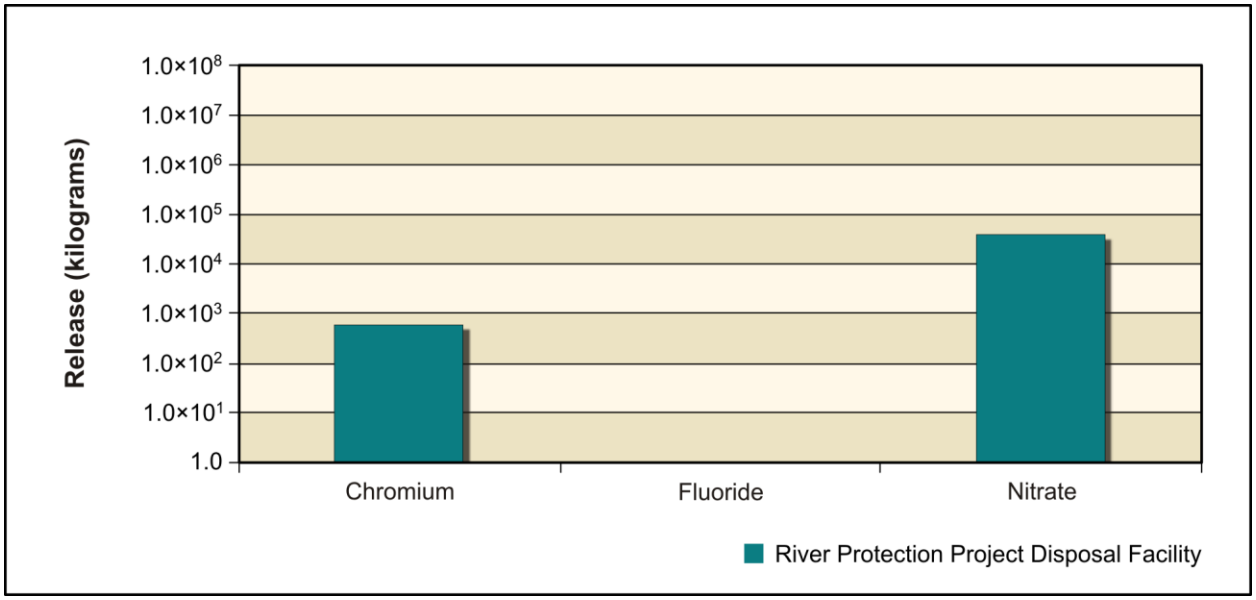


Figure 5–390. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–391 shows the estimated release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–392, the chemical hazard drivers. Both figures show trends similar to those discussed above for the release of all COPC drivers from IDF-East to the Columbia River.

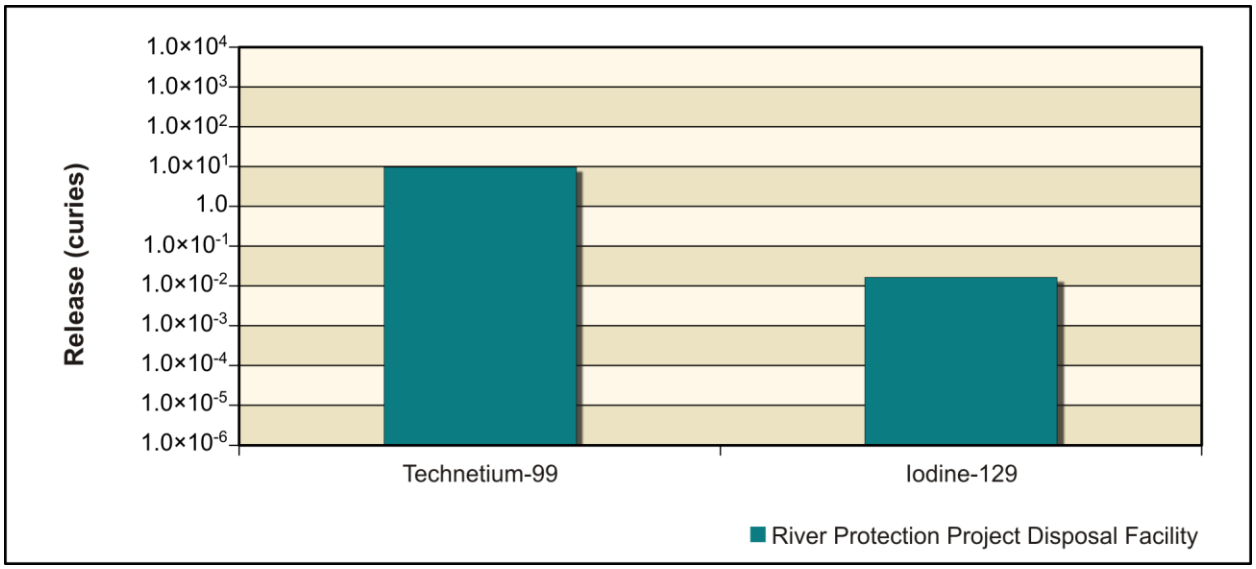


Figure 5–391. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

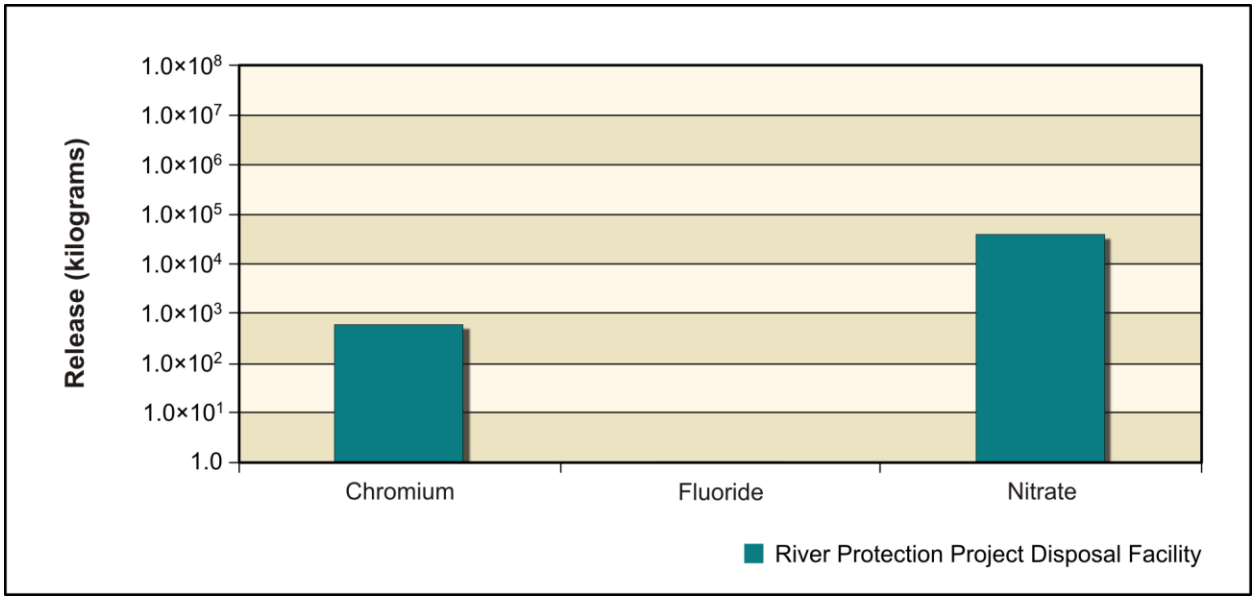


Figure 5–392. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Disposal Group 1, Subgroup 1-A, impacts in terms of groundwater concentration versus time at the RPPDF barrier, IDF-East barrier, Core Zone Boundary, and Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–393 through 5–396). The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over five orders of magnitude.

Table 5–94 lists the maximum concentrations of the COPCs in the peak year at IDF-East and the RPPDF, Core Zone Boundary, and Columbia River nearshore. Under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, peak concentrations of technetium-99 and iodine-129 exceed their benchmarks

only at the IDF-East barrier in CY 7826 and CY 7907, respectively. No other constituents exceed their benchmark concentrations under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, at the IDF-East barrier, RPPDF barrier, Core Zone Boundary, or Columbia River nearshore.

Figures 5–393 through 5–396 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers). Releases from IDF-East and the RPPDF cause iodine-129 concentrations at the RPPDF barrier, Core Zone Boundary, and Columbia River nearshore to come within two to three orders of magnitude of the benchmark around CY 4000. A second peak in iodine-129 causes concentrations at the IDF-East barrier to exceed the benchmark concentration by less than one order of magnitude from about CY 6500 to CY 9000. During this same time period, concentrations of iodine-129 at the Core Zone Boundary and Columbia River nearshore approach the benchmark. The same trend is evident for technetium-99 concentrations during the period of analysis. Chromium and nitrate measurements show a trend similar to iodine-129 and technetium-99, but never exceed benchmark concentrations. The concentrations of total uranium remain below the threshold concentration of 1.0×10^{-8} picocuries per liter (uranium-238) or micrograms per liter (total uranium) to be considered COPC drivers for Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A.

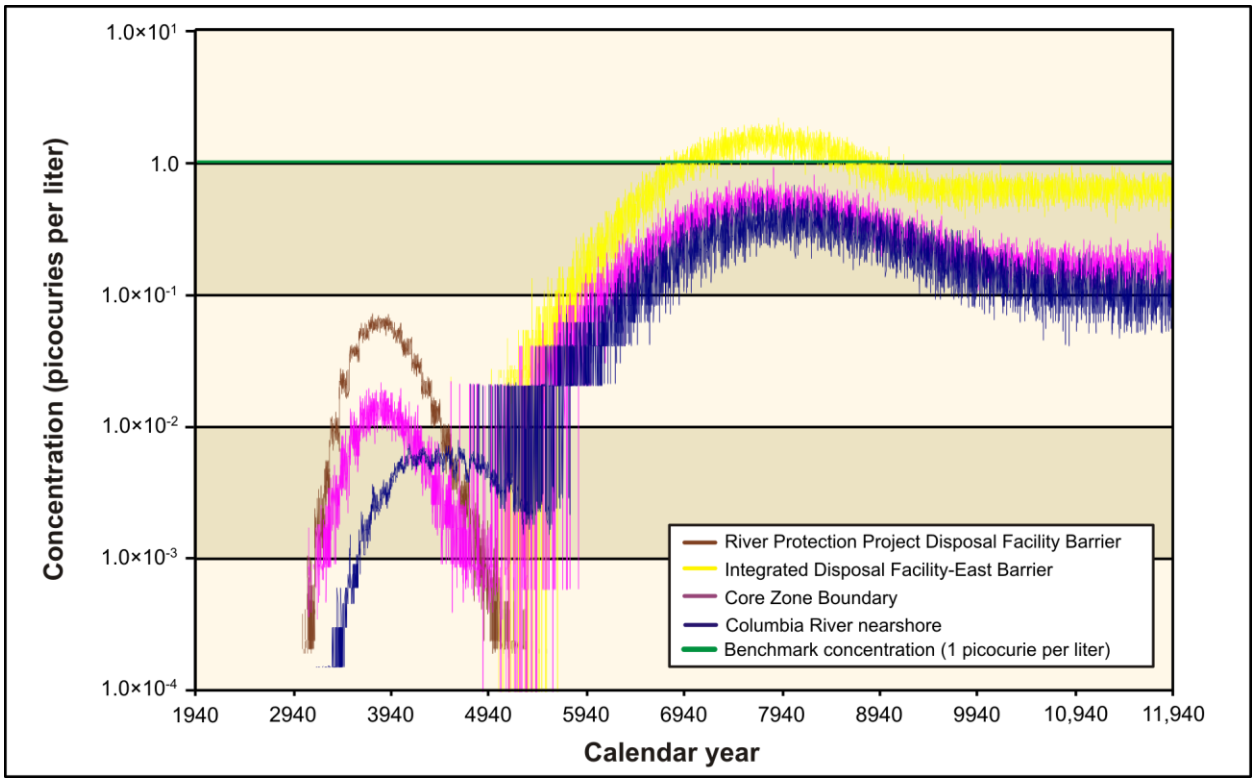


Figure 5–393. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Iodine-129 Concentration Versus Time

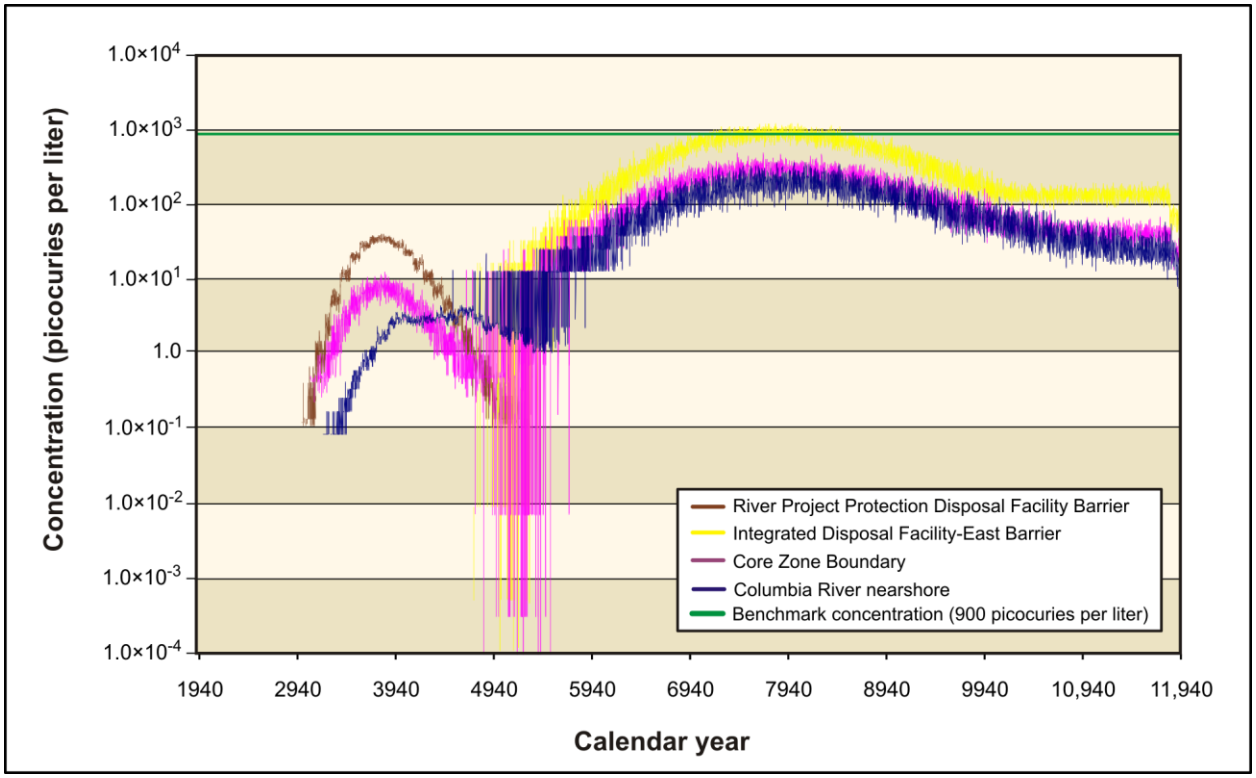


Figure 5–394. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Technetium-99 Concentration Versus Time

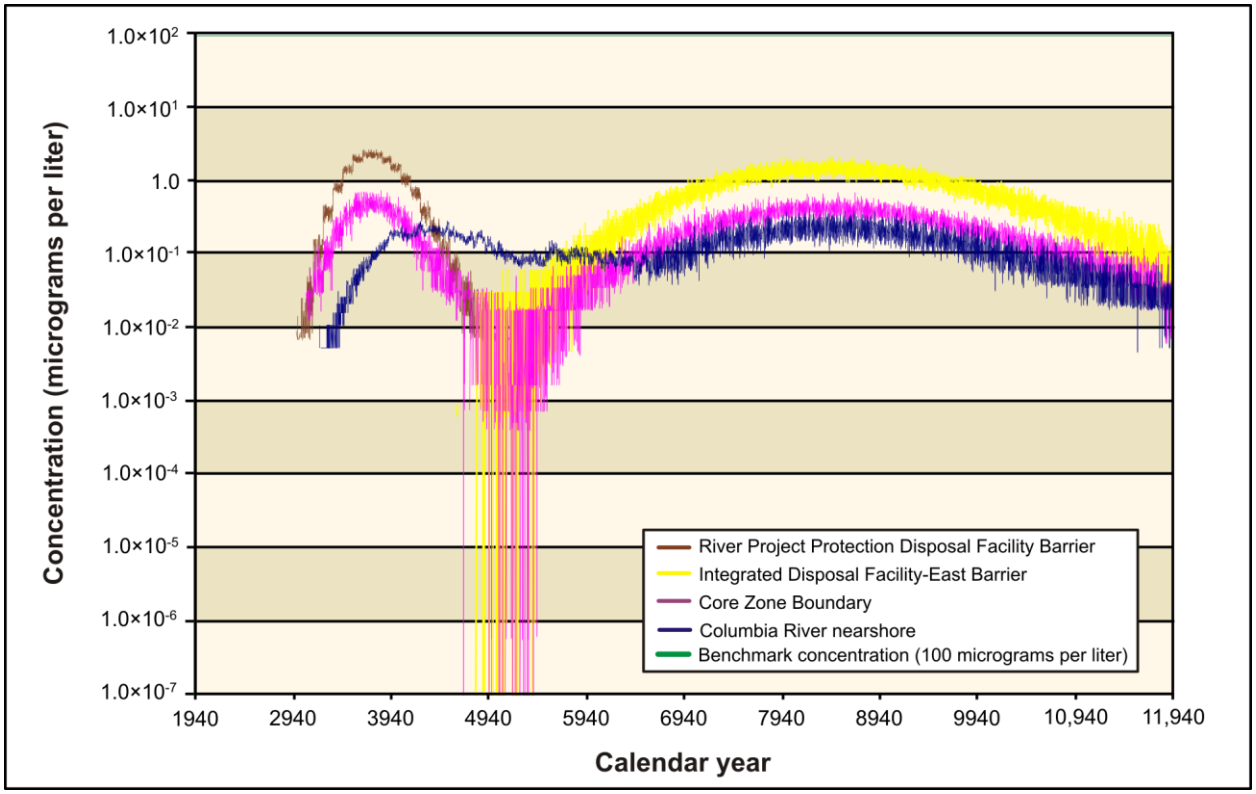


Figure 5–395. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Chromium Concentration Versus Time

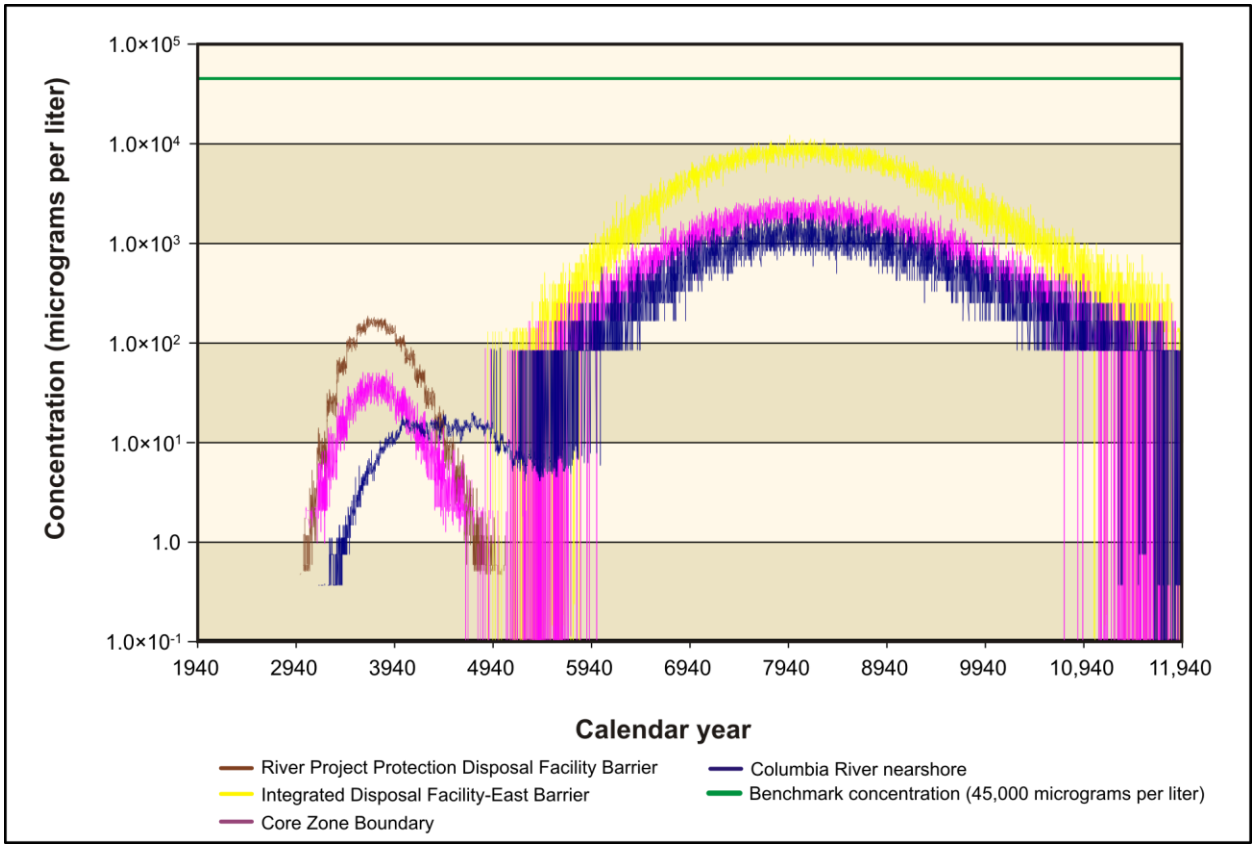


Figure 5–396. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Nitrate Concentration Versus Time

Table 5–94. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Maximum COPC Concentrations in the Peak Year at IDF-East and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)					
Technetium-99	**1,260** (7826)	42 (3818)	497 (7709)	377 (8130)	900
Iodine-129	**2.1** (7907)	0.1 (3747)	0.9 (7856)	0.7 (8067)	1
Chemical (micrograms per liter)					
Chromium	2 (8438)	3 (3740)	1 (3846)	0 (8236)	100
Nitrate	12,100 (7962)	180 (3670)	3,010 (8248)	2,030 (7535)	45,000

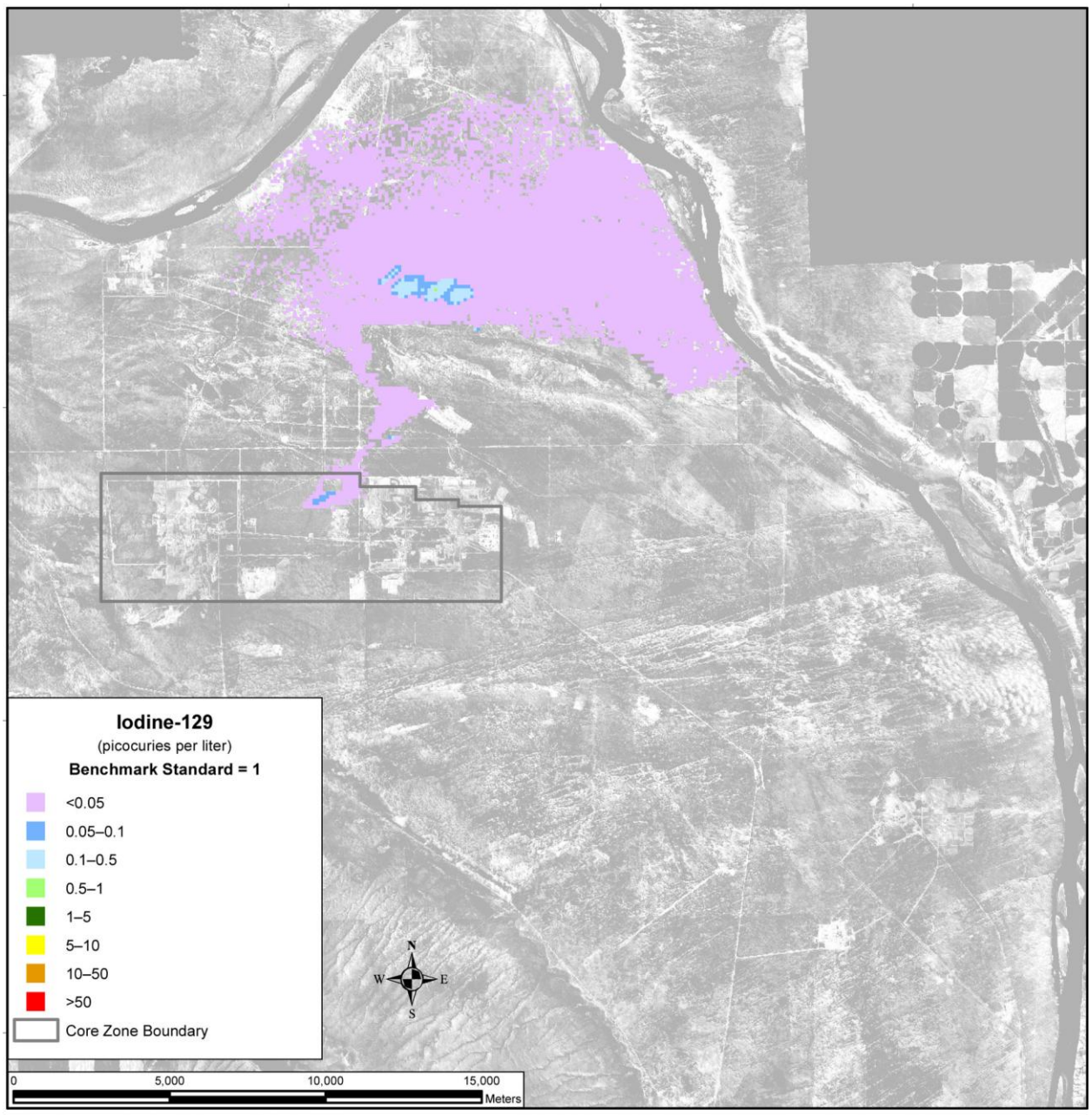
Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

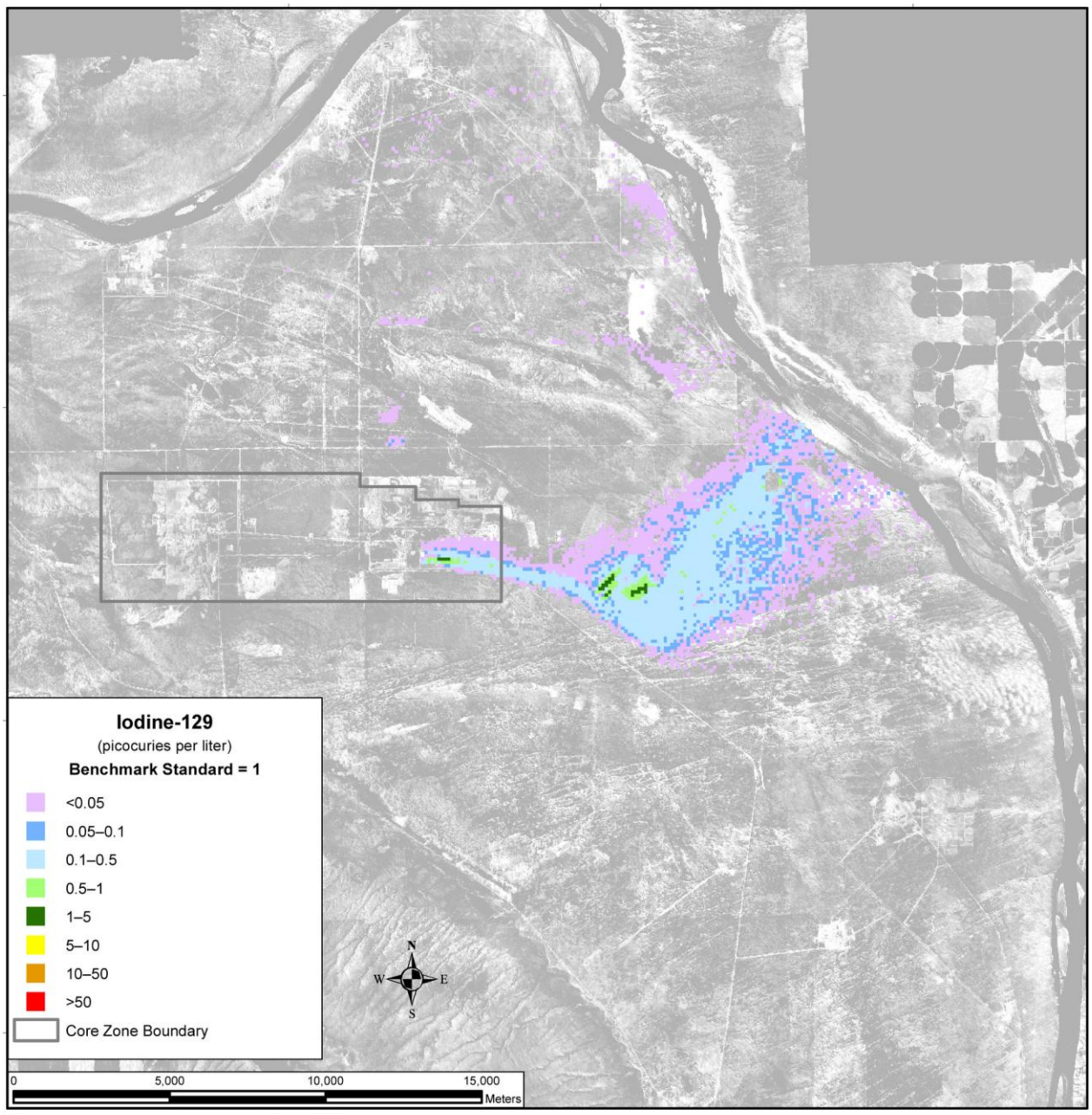
This section presents the impacts of Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–397 through 5–408). Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

Figures 5–397 through 5–399 show the spatial distribution of iodine-129 concentrations in groundwater. In CY 3890, there is a low-concentration plume that stretches north from the RPPDF through Gable Gap. By CY 7140, the plume from the RPPDF has attenuated, but a new plume has formed, traveling east from IDF-East. The peak concentrations in this plume are one to five times greater than the benchmark. By CY 11,885, the IDF-East plume continues to spread toward the river, and the concentrations within it remain relatively the same. Technetium-99 (see Figures 5–400 through 5–402), chromium (see Figures 5–403 through 5–405), and nitrate (see Figures 5–406 through 5–408) show similar spatial distributions at selected times. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., move at the rate of the pore-water velocity). Iodine-129 and technetium-99 are the only conservative tracers to have values over their benchmarks from the plume originating in IDF-East.



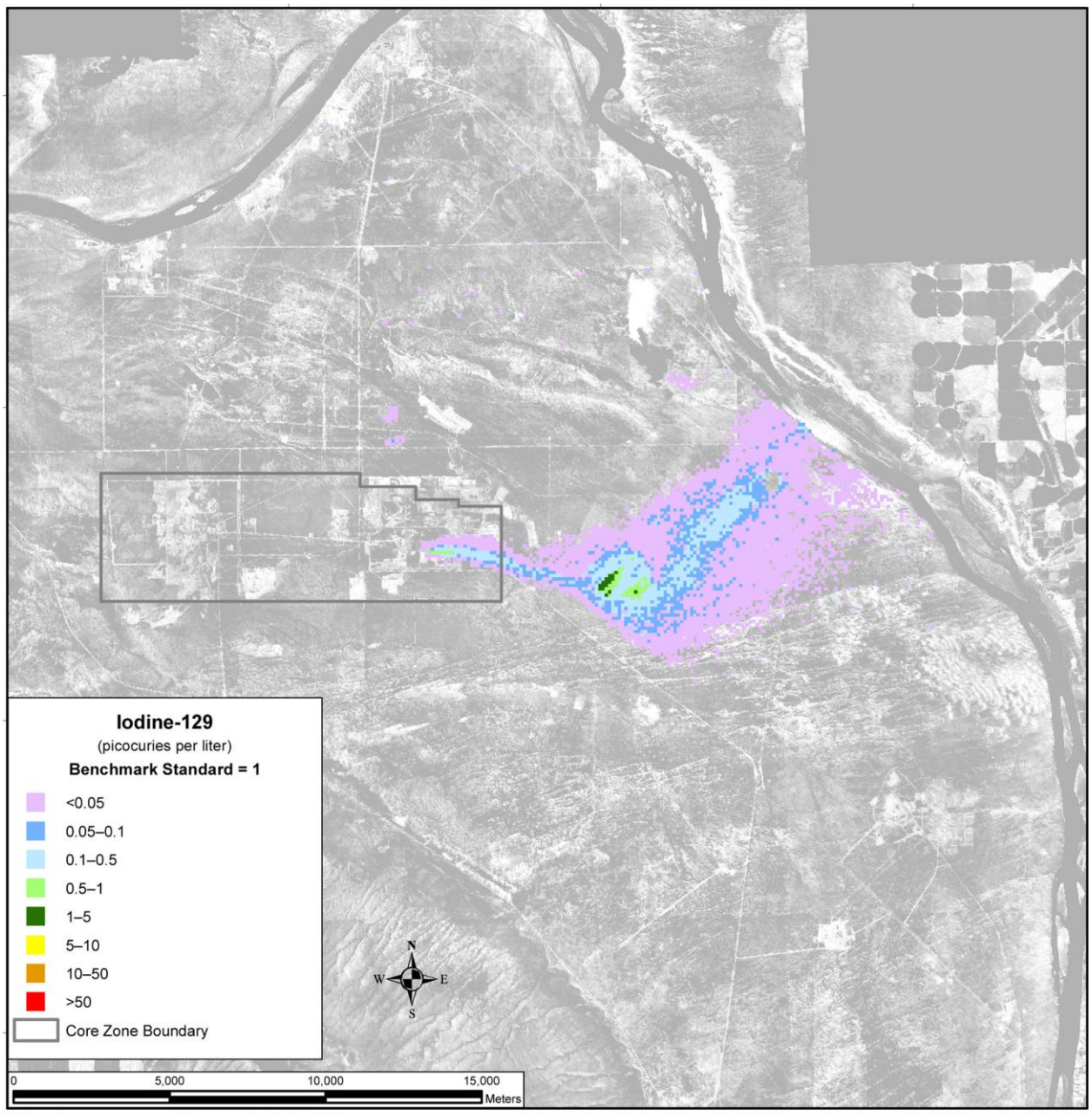
Note: To convert meters to feet, multiply by 3.281.

Figure 5–397. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



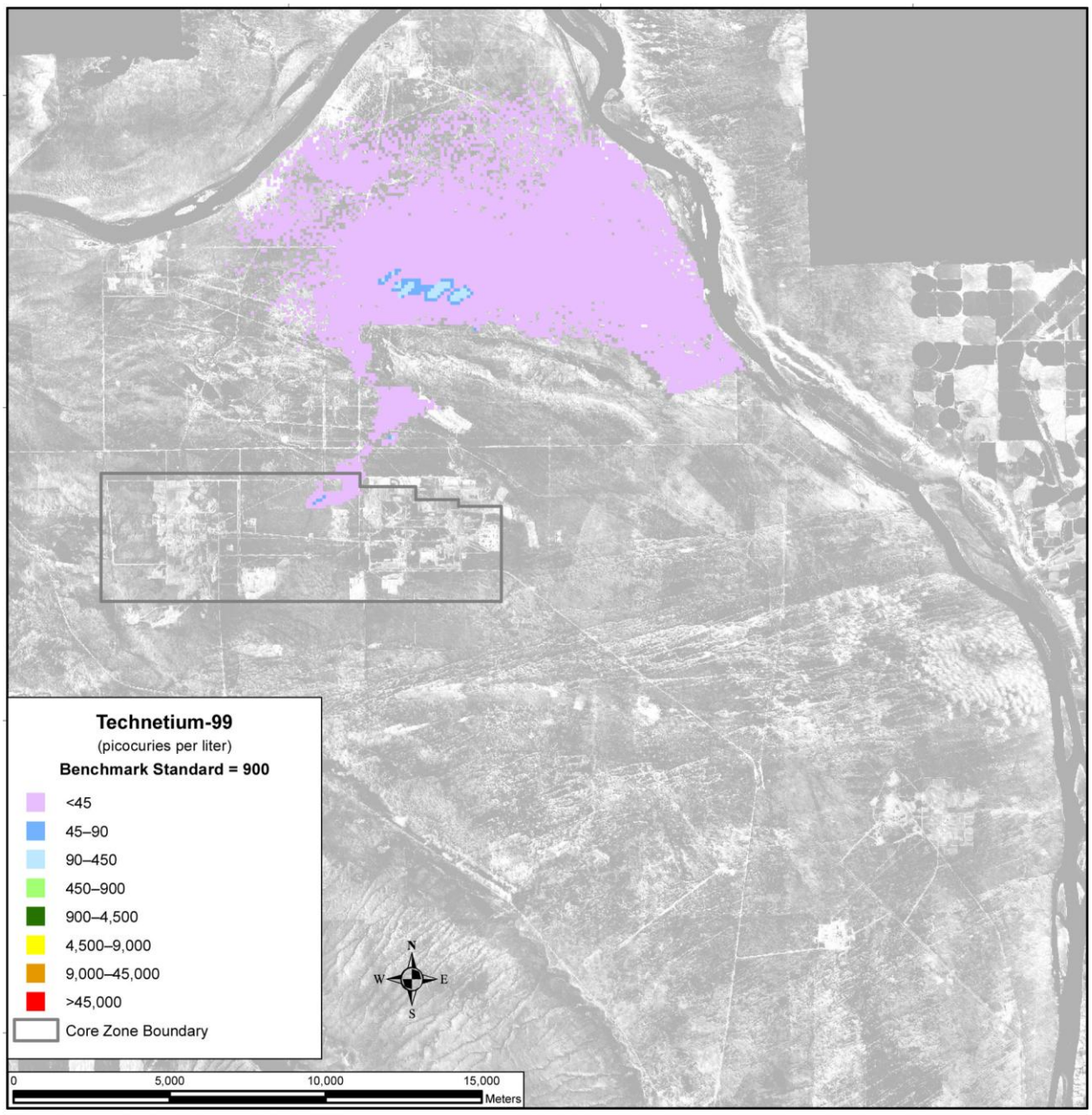
Note: To convert meters to feet, multiply by 3.281.

Figure 5–398. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



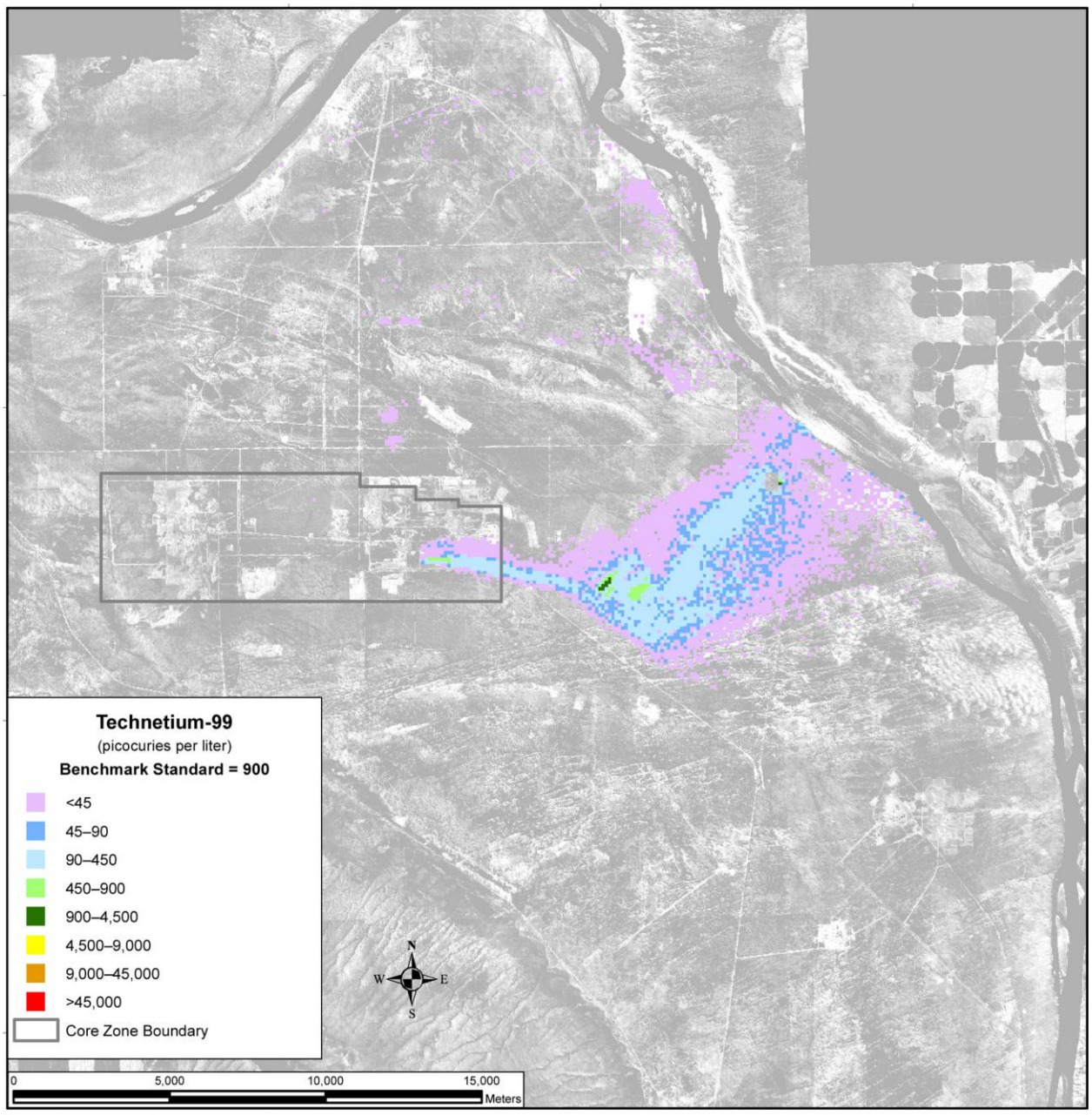
Note: To convert meters to feet, multiply by 3.281.

Figure 5–399. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



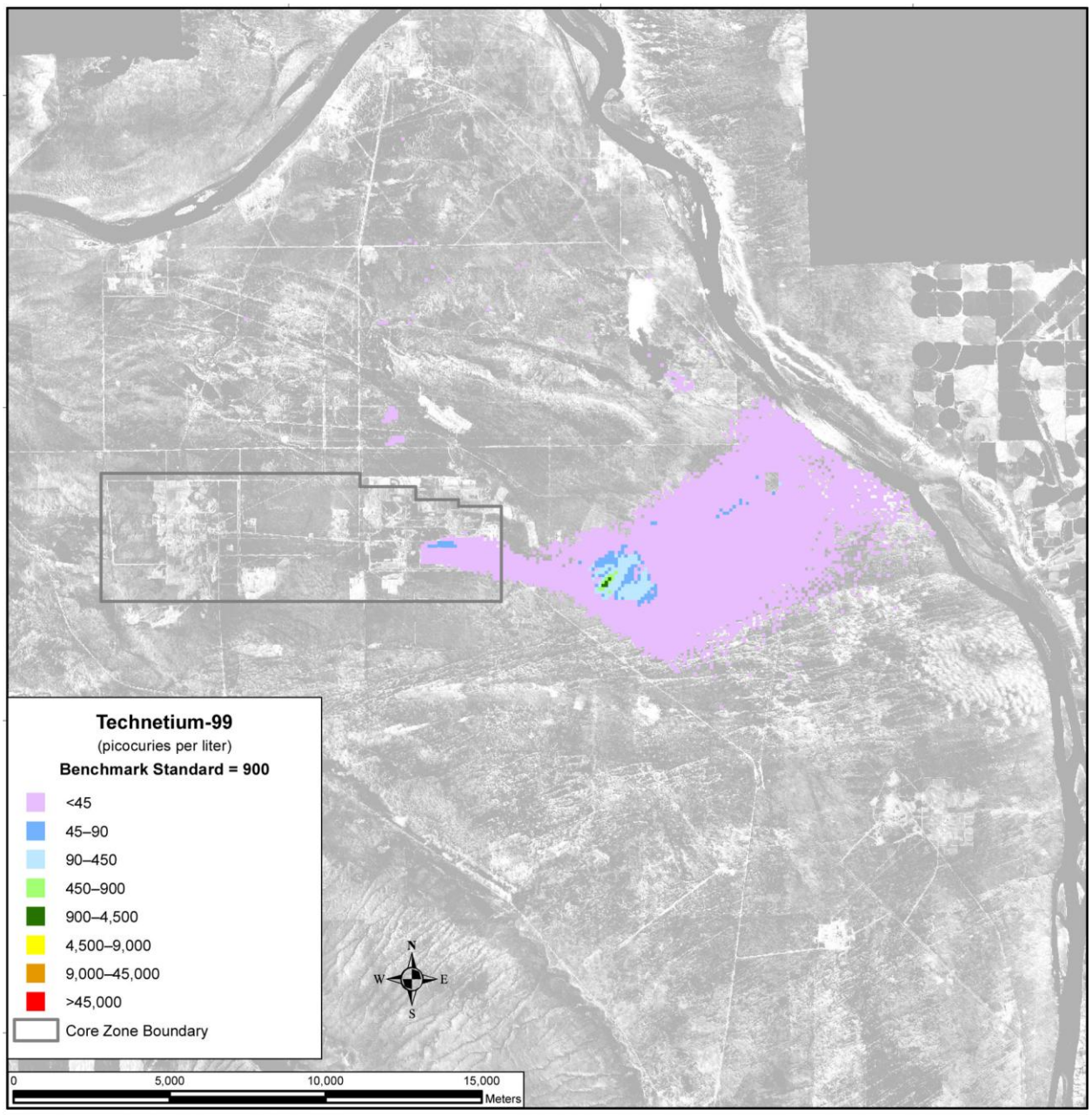
Note: To convert meters to feet, multiply by 3.281.

Figure 5–400. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



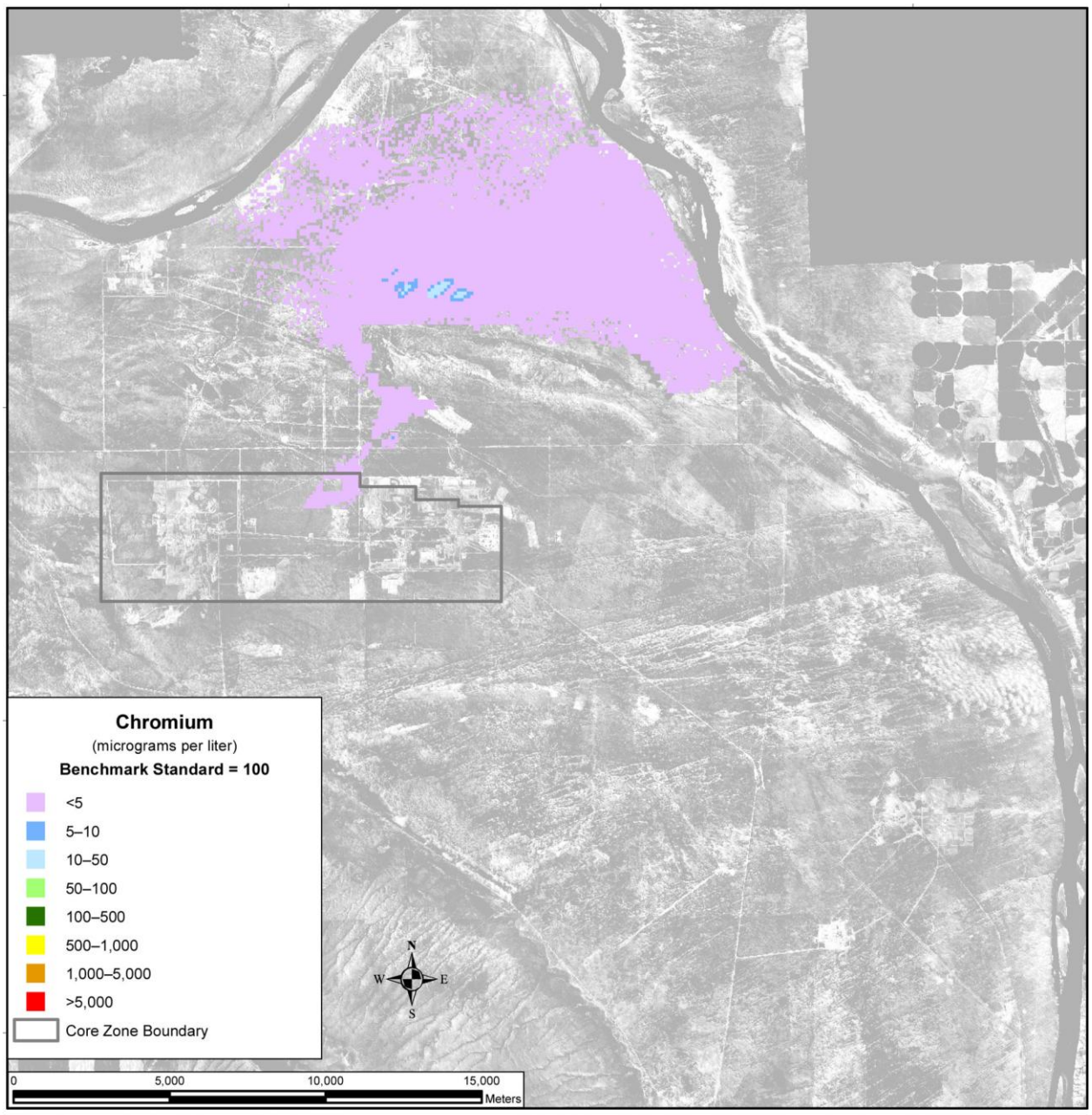
Note: To convert meters to feet, multiply by 3.281.

Figure 5–401. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



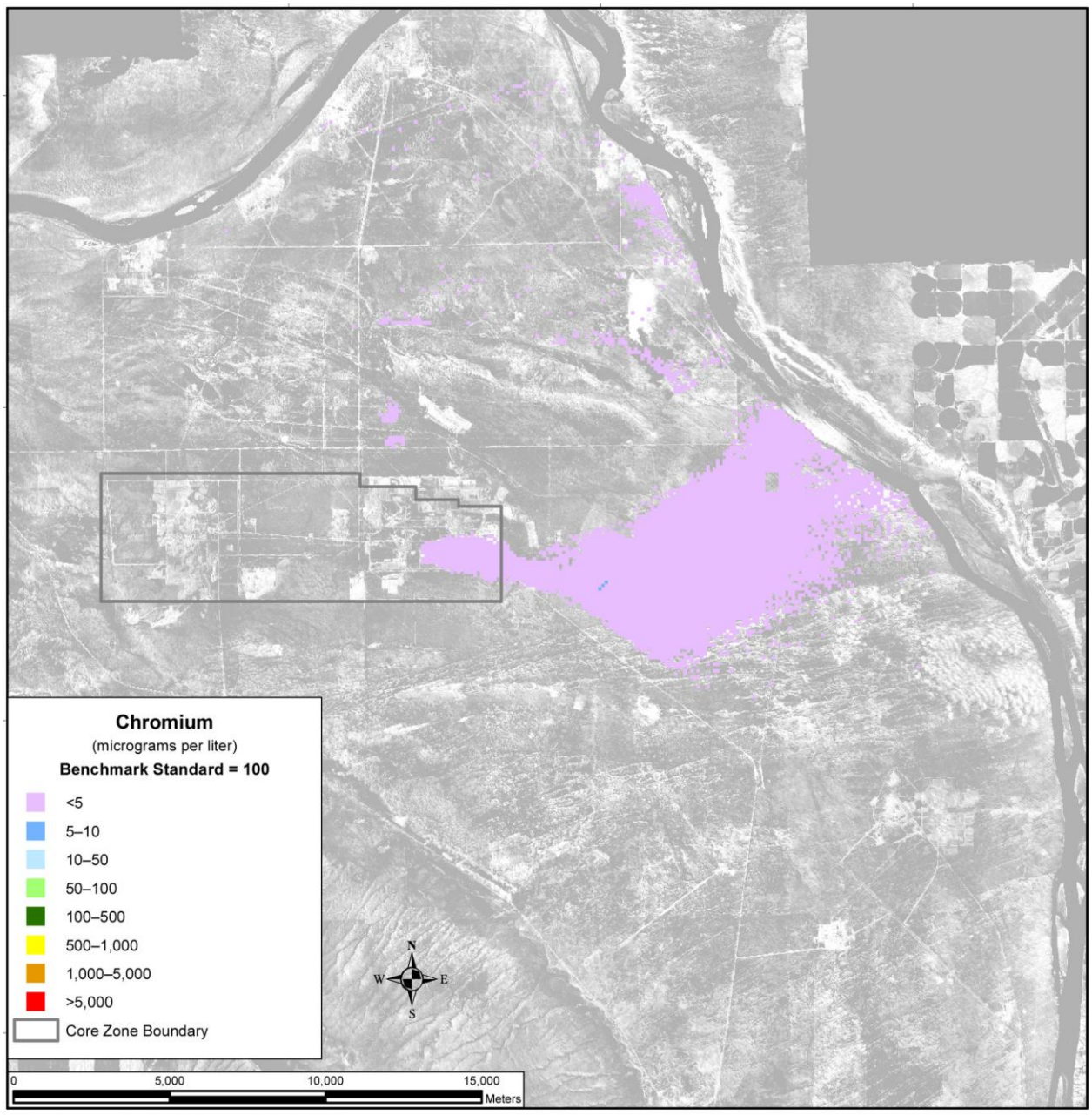
Note: To convert meters to feet, multiply by 3.281.

Figure 5–402. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



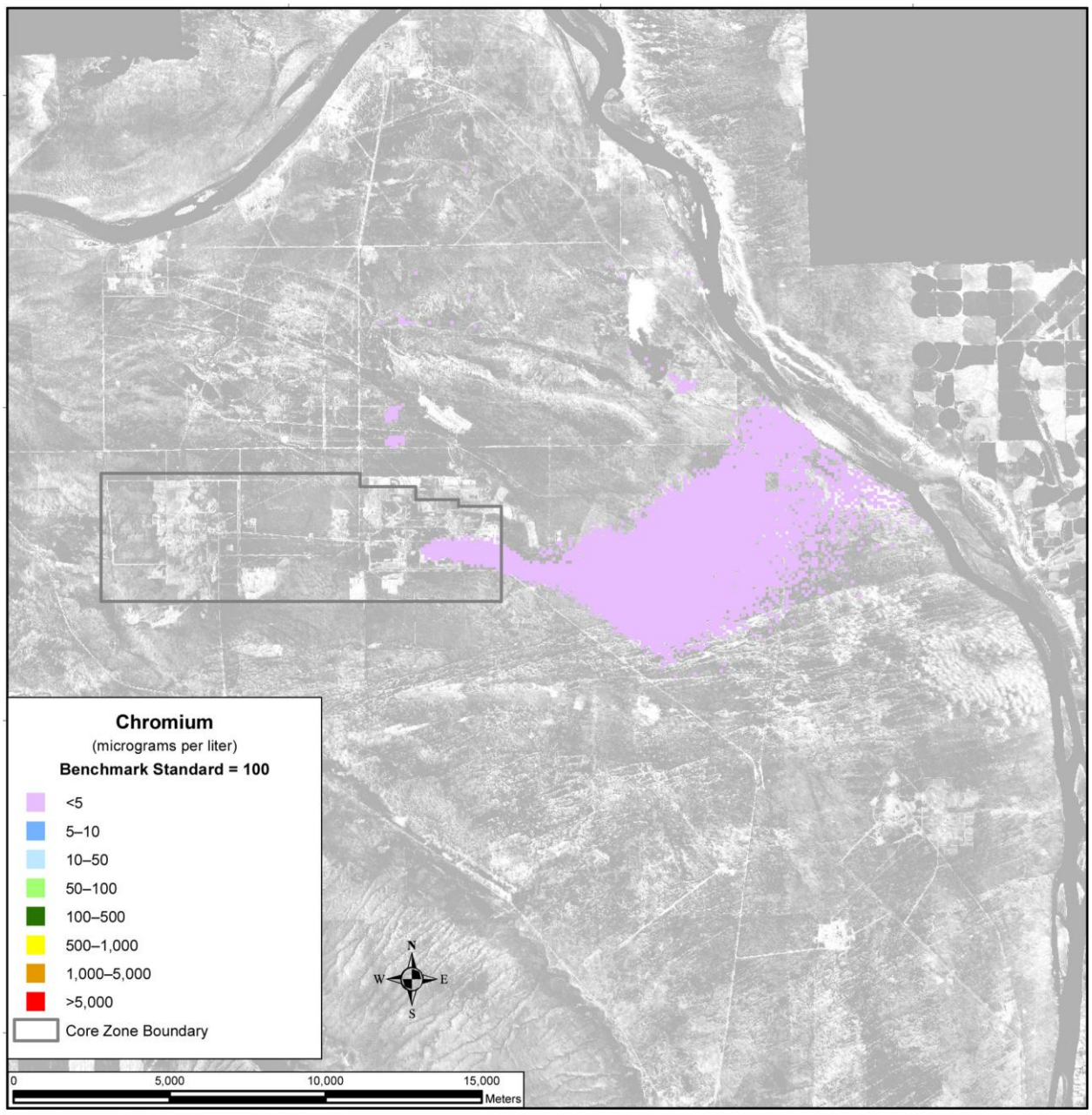
Note: To convert meters to feet, multiply by 3.281.

Figure 5–403. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



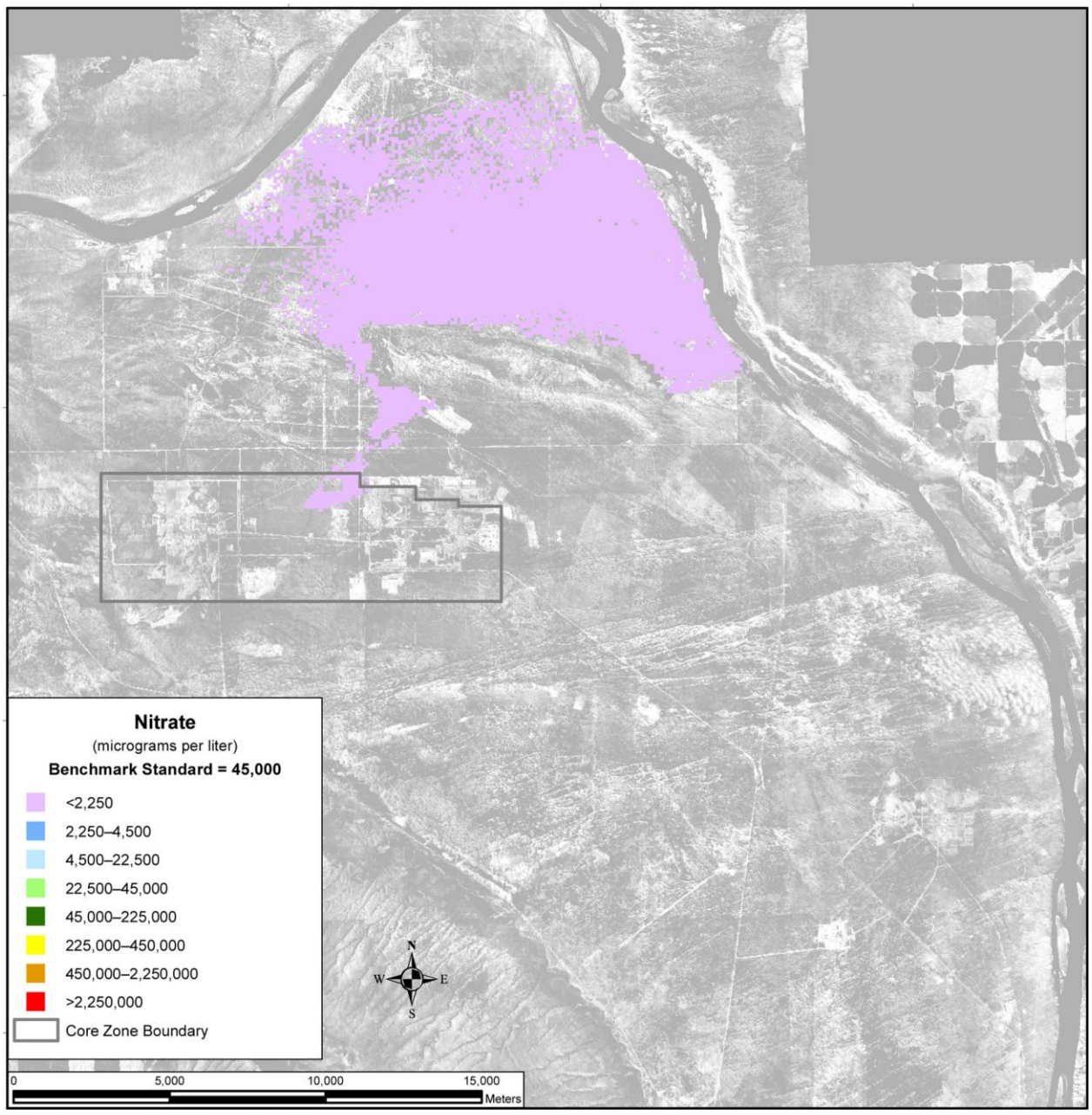
Note: To convert meters to feet, multiply by 3.281.

Figure 5–404. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



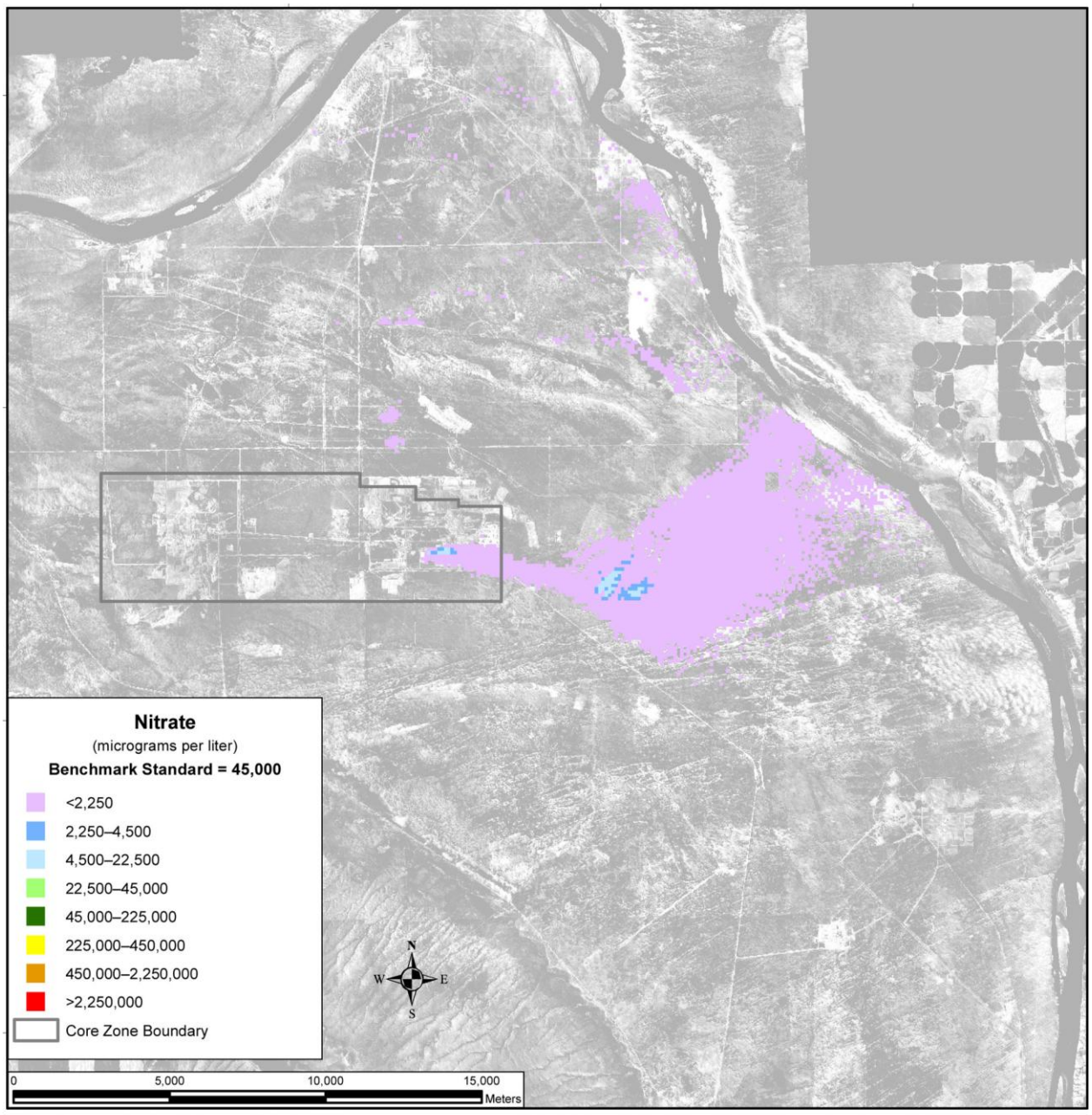
Note: To convert meters to feet, multiply by 3.281.

Figure 5–405. Waste Management Alternative 2, Disposal Group 1 Subgroup 1-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



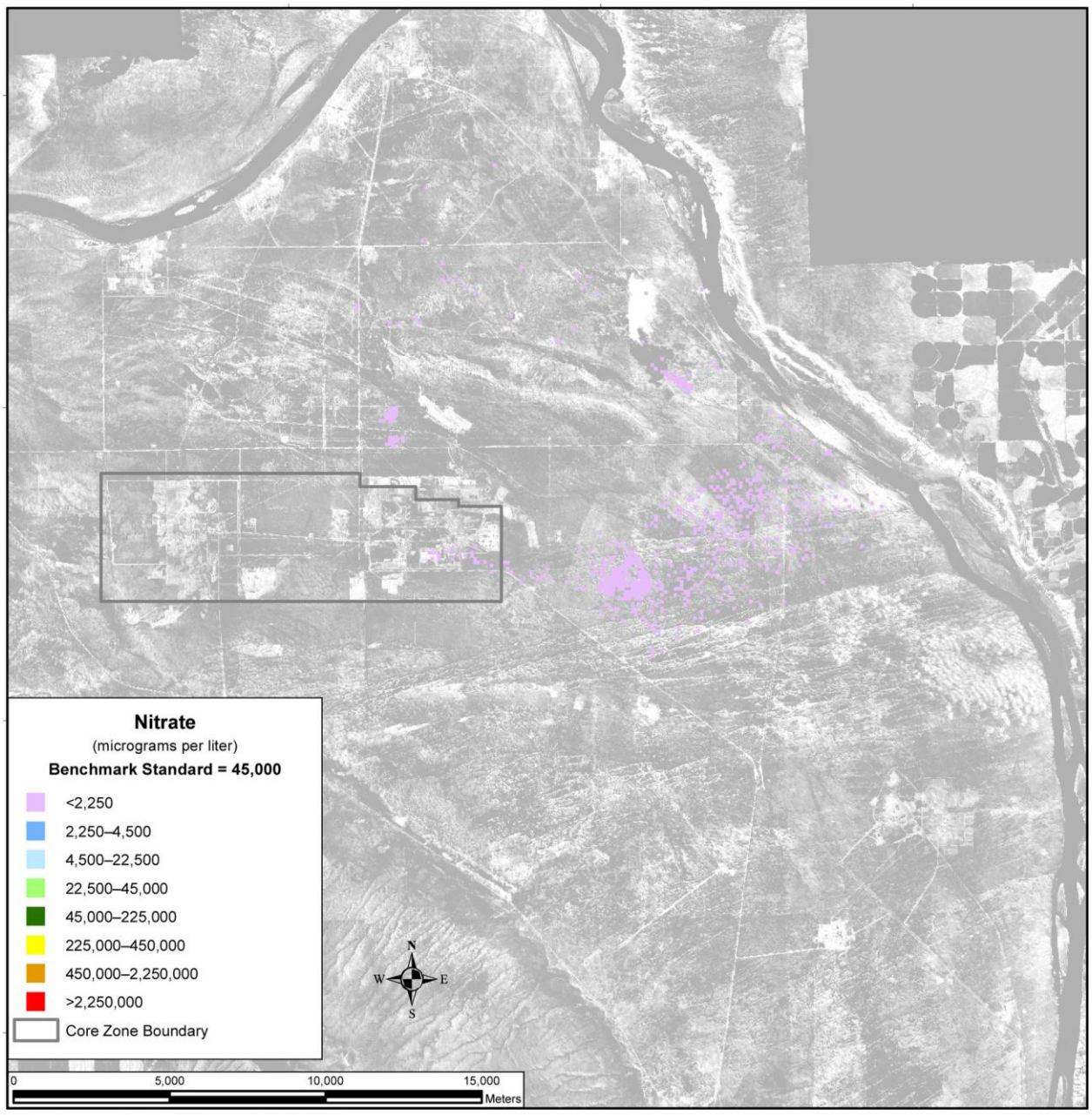
Note: To convert meters to feet, multiply by 3.281.

Figure 5–406. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–407. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–408. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

No appreciable concentrations of total uranium result in contaminant plumes under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, so figures of plume maps for the uranium constituents are not shown.

SUMMARY OF IMPACTS

Under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, in general, the inventory remaining in IDF-East, available for release to the environment at the start of the post-disposal period, is the predominant contributor to groundwater contamination from the conservative tracers iodine-129, technetium-99, chromium, and nitrate. Releases from the RPPDF occur earlier and releases from

IDF-East occur later in the simulation period. The inventory available for release from the RPPDF during the post-disposal period is a secondary contributor.

For the conservative tracers, only iodine-129 and technetium-99 concentrations originating from IDF-East exceed benchmark standards by less than one order of magnitude from about CY 6500 to CY 9000. Concentrations at the Core Zone Boundary, Columbia River nearshore, and RPPDF barrier never meet or exceed the benchmark during the period of analysis.

The concentration of total uranium remains below the threshold concentration of 1.0×10^{-8} micrograms per liter and is not a COPC driver under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A.

5.3.1.2.1.2 Disposal Group 1, Subgroup 1-B

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Disposal Group 1, Subgroup 1-B, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 3A and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Waste would be converted to IHLW, ILAW glass, and bulk vitrification glass. IHLW would be stored on site, while ILAW glass and bulk vitrification glass would be disposed of in IDF-East.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and the RPPDF in CY 2009 and continue through CY 2050, when these facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.
- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in the facilities would become available for release to the environment, and modified RCRA Subtitle C barriers would be emplaced over IDF-East and the RPPDF to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 2. Complete results for all 40 COPCs are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 2 were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 2.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, in terms of the total amount of COPCs released to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms (see Figures 5–409 through 5–420). Eight subtotals are plotted, representing releases from ILAW glass, bulk vitrification glass, ETF-generated secondary waste, retired melters, tank closure secondary waste, FFTF Decommissioning Alternative 3 waste, waste management secondary waste, and onsite and offsite waste. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over eight orders of magnitude within the same series of figures.

Figure 5–409 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–410, the chemical hazard drivers. For bulk vitrification castable refractory and offsite wastes, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). The predominant sources of technetium-99 are bulk vitrification glass and offsite waste; those of iodine-129 are offsite waste and ETF-generated secondary waste; those of chromium are tank closure secondary waste, waste management secondary waste, and onsite and offsite waste; those of fluoride are waste management secondary waste and onsite waste; and that of nitrate is ETF-generated secondary waste.

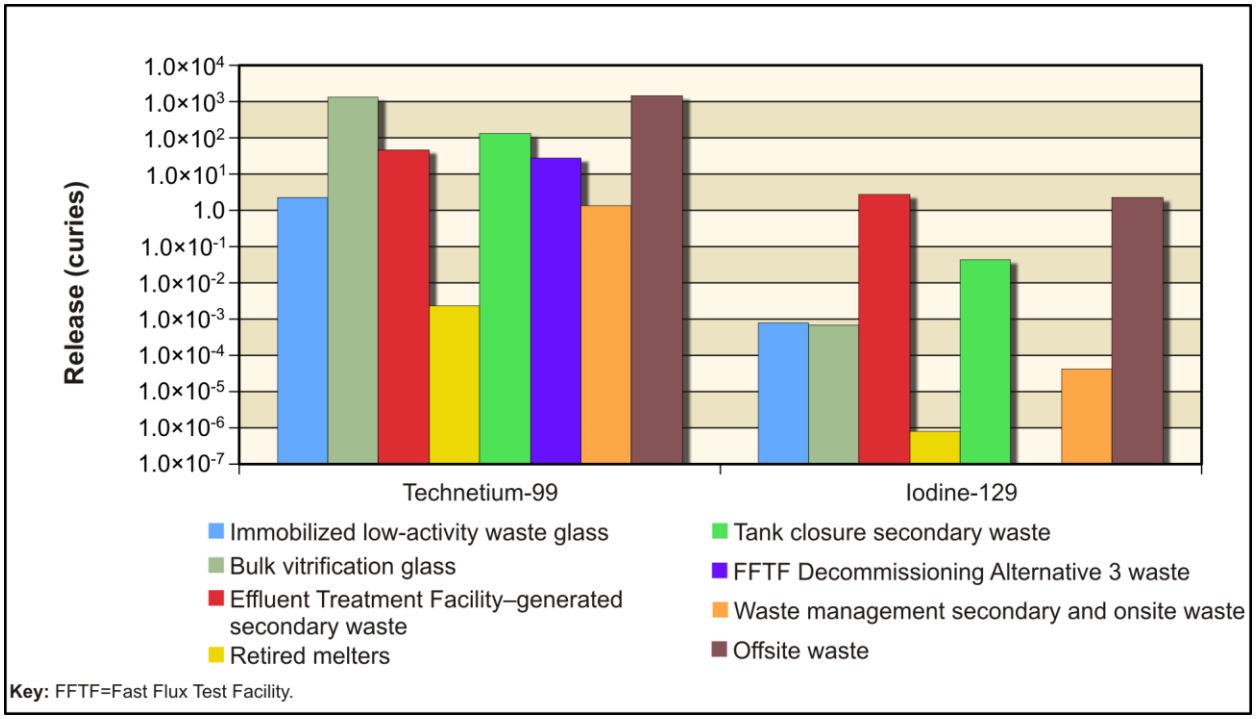


Figure 5–409. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

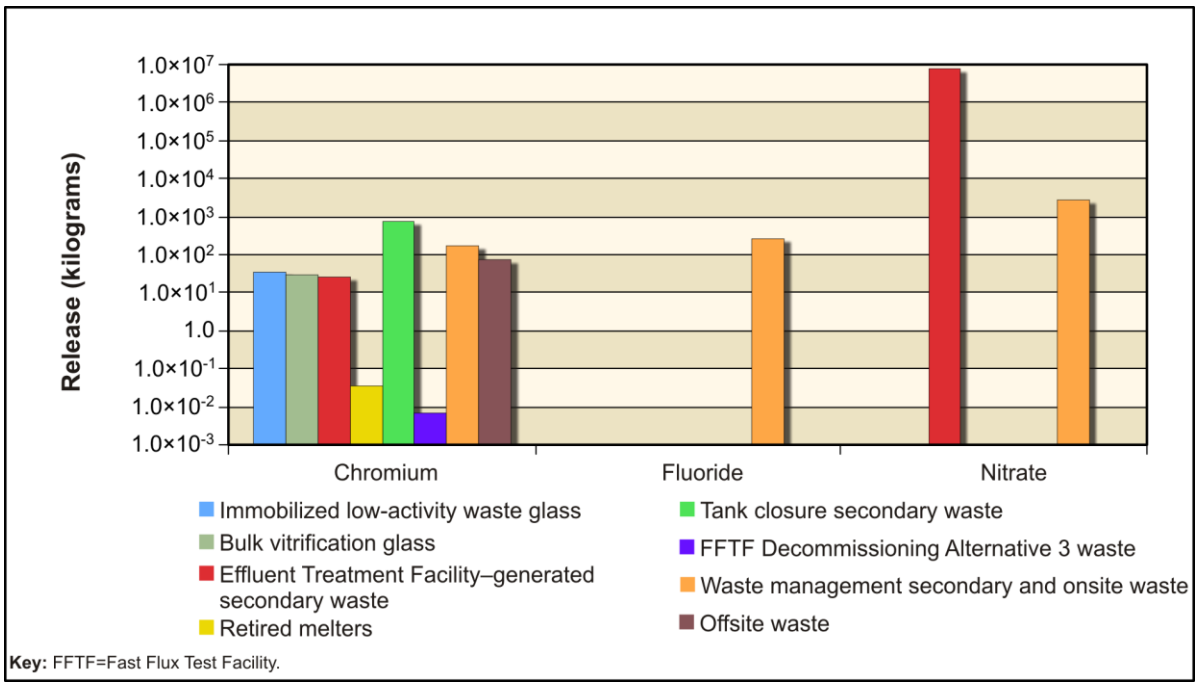


Figure 5–410. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–411 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–412, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Approximately 96 percent of the technetium-99 and 69 percent of the iodine-129 released to the vadose zone reach groundwater in the analysis, as well as nearly all of the chromium, fluoride, and nitrate.

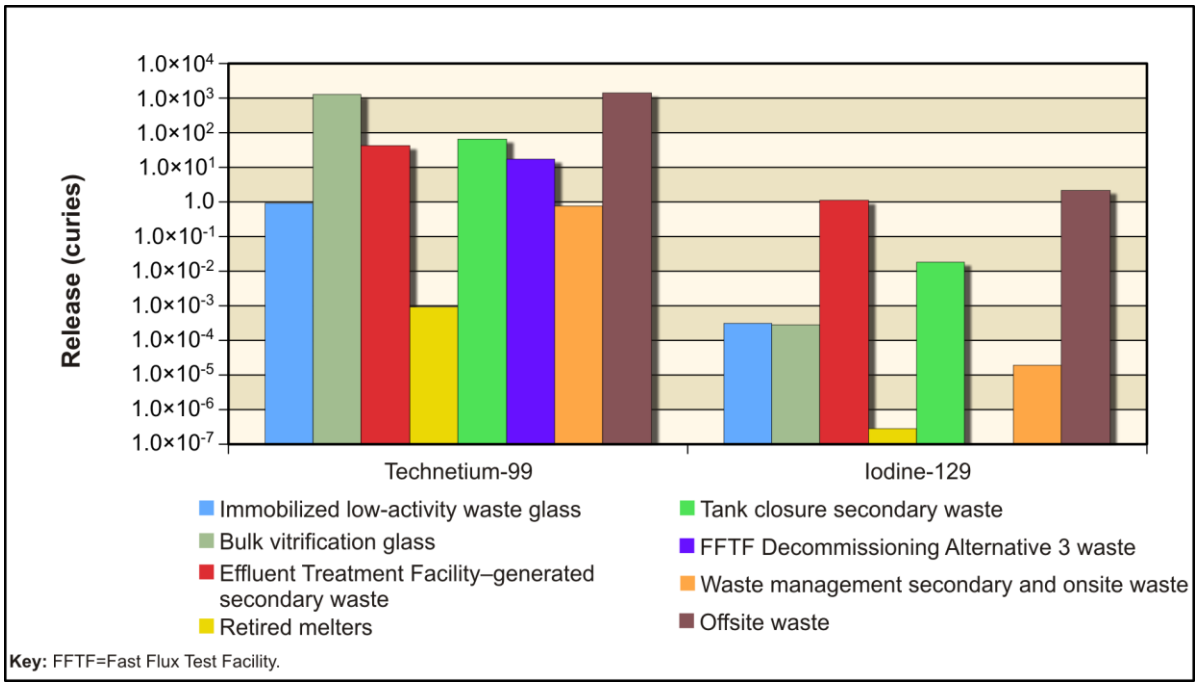


Figure 5–411. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

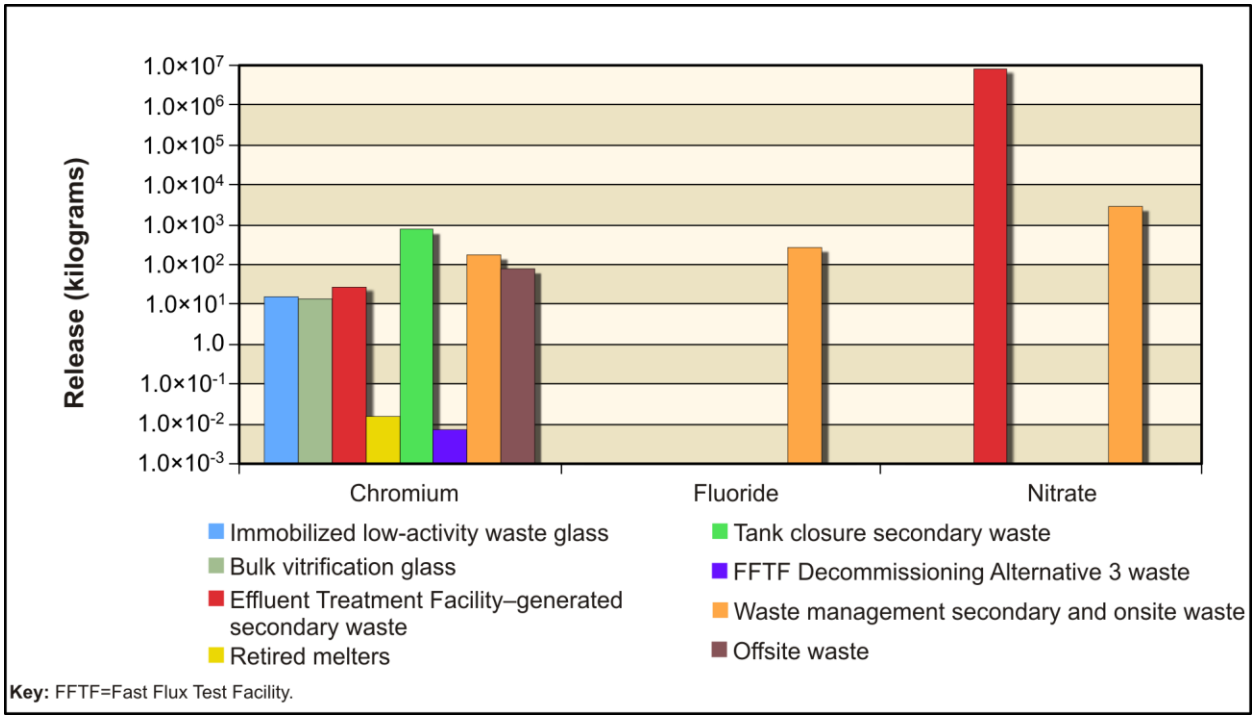


Figure 5–412. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–413 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–414, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99 and iodine-129, about 95 percent and 67 percent of the total amounts released from the vadose zone reach the Columbia River in the analysis, respectively. For chromium, about 98 percent reaches the Columbia River; for fluoride and nitrate, about 100 percent.

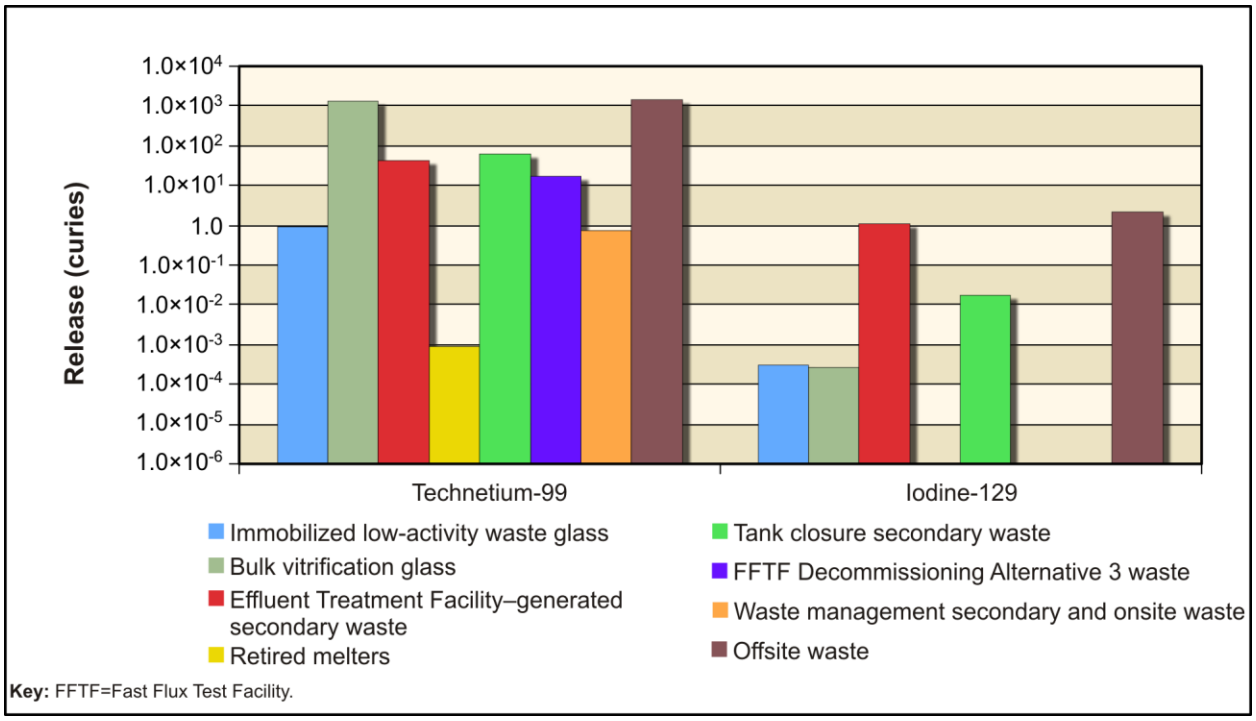


Figure 5–413. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

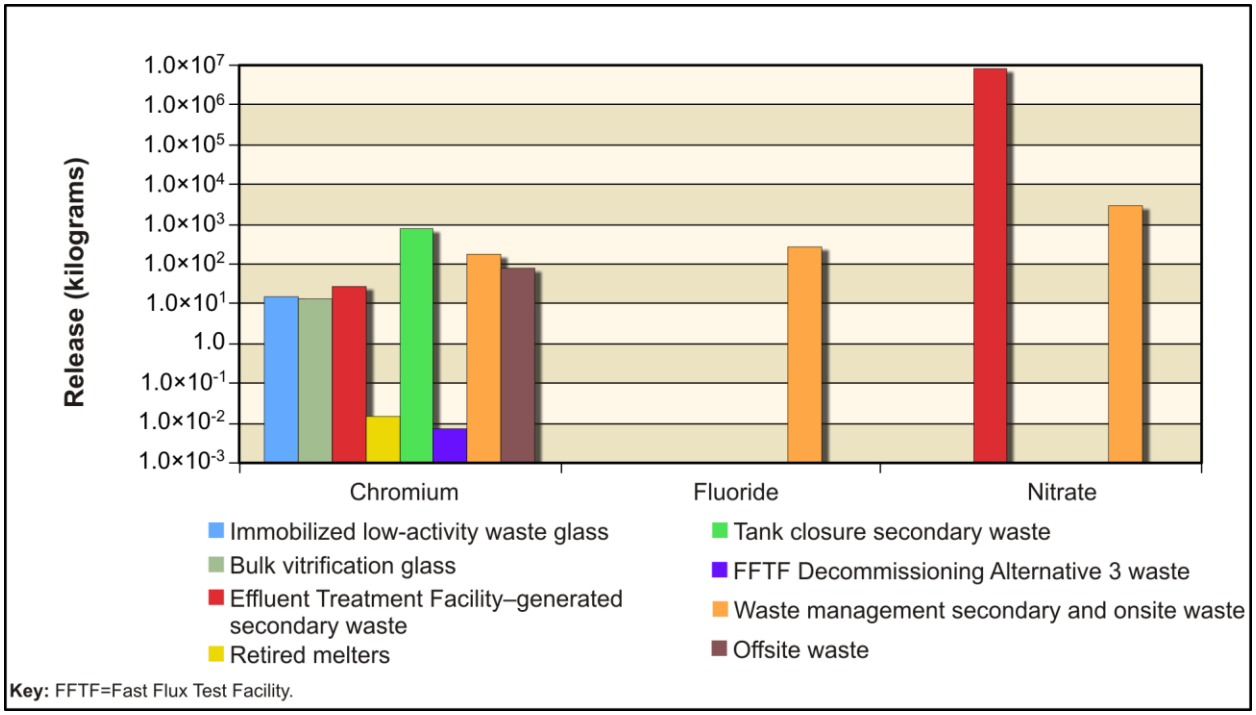


Figure 5–414. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

Figure 5–415 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–416, the chemical hazard drivers. For all types of sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of

analysis). Technetium-99, iodine-129, chromium, and nitrate are all present at the RPPDF in the analysis (fluoride is not).

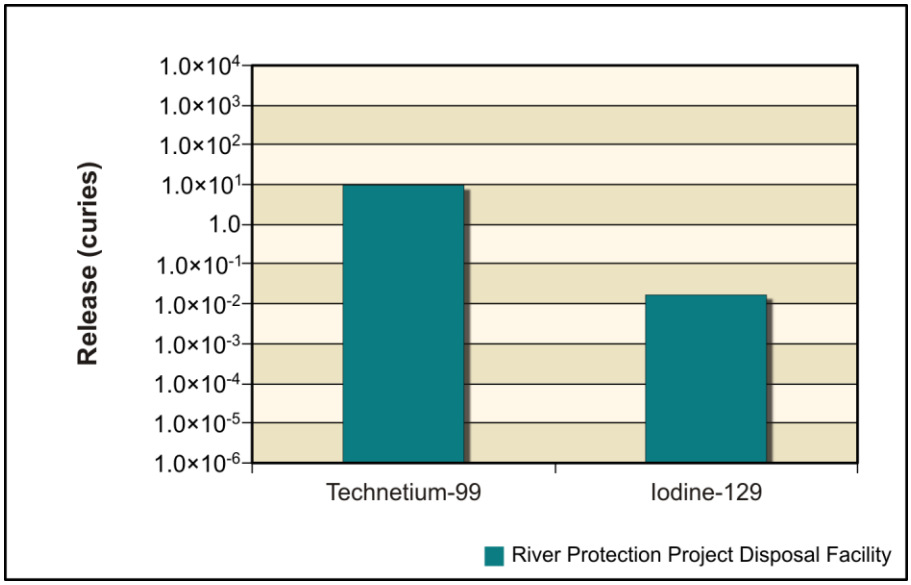


Figure 5–415. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

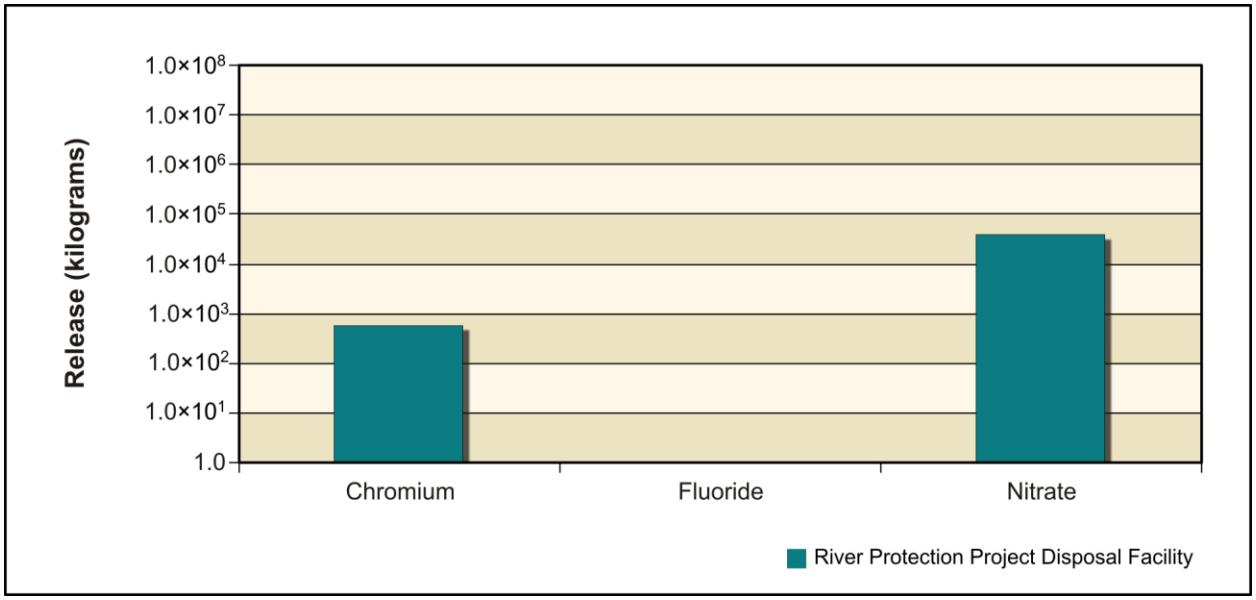


Figure 5–416. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–417 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–418, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present at the RPPDF behave as conservative tracers, with essentially all of the mass released to the vadose zone reaching groundwater.

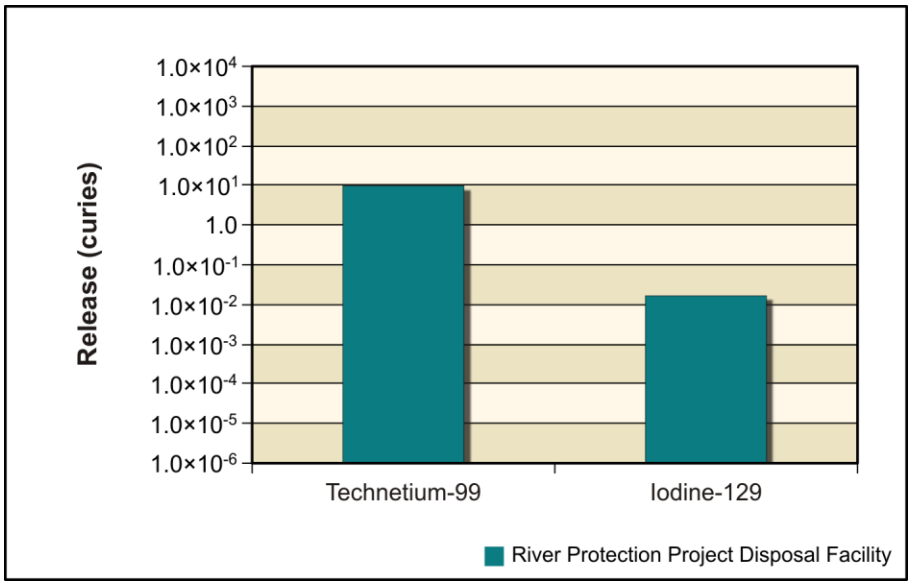


Figure 5–417. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

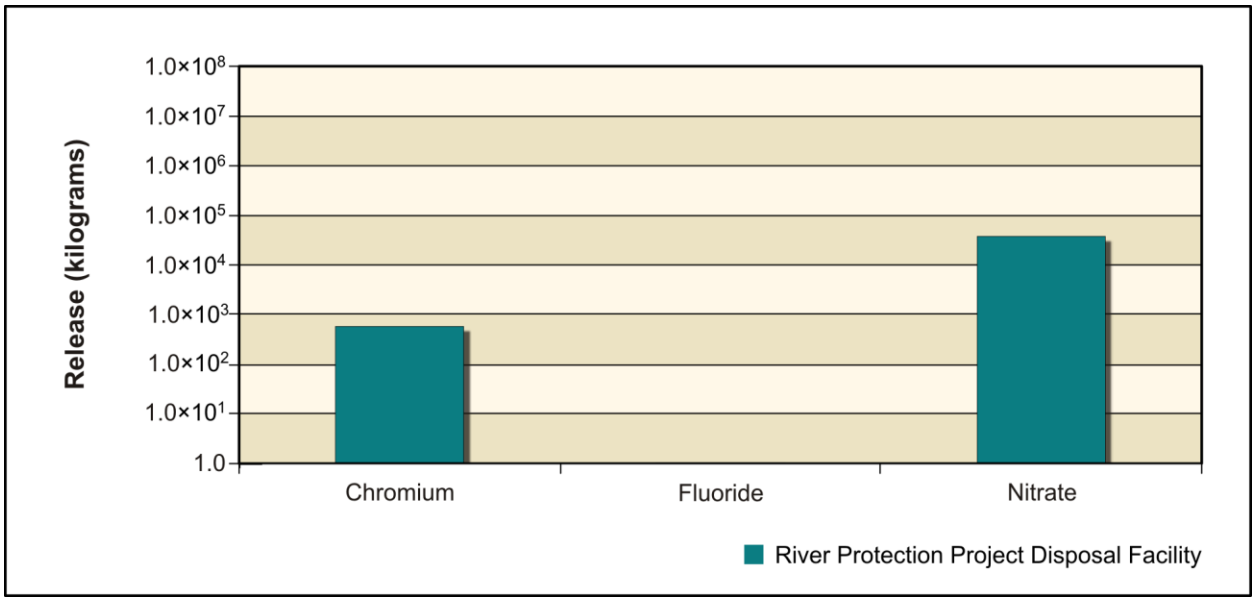


Figure 5–418. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–419 shows the estimated release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–420, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, and nitrate, approximately 100 percent of the total amounts released to the vadose zone from the RPPDF reach the Columbia River in the analysis.

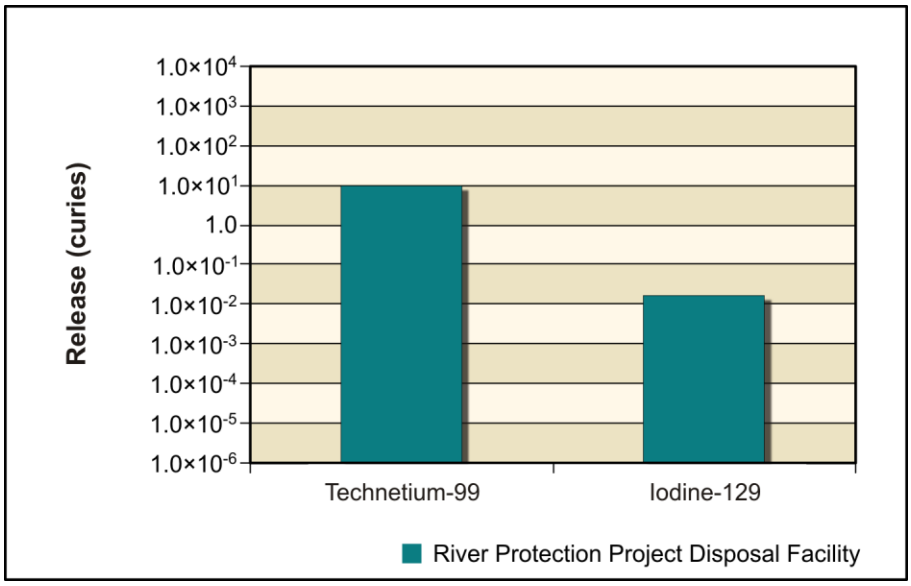


Figure 5–419. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

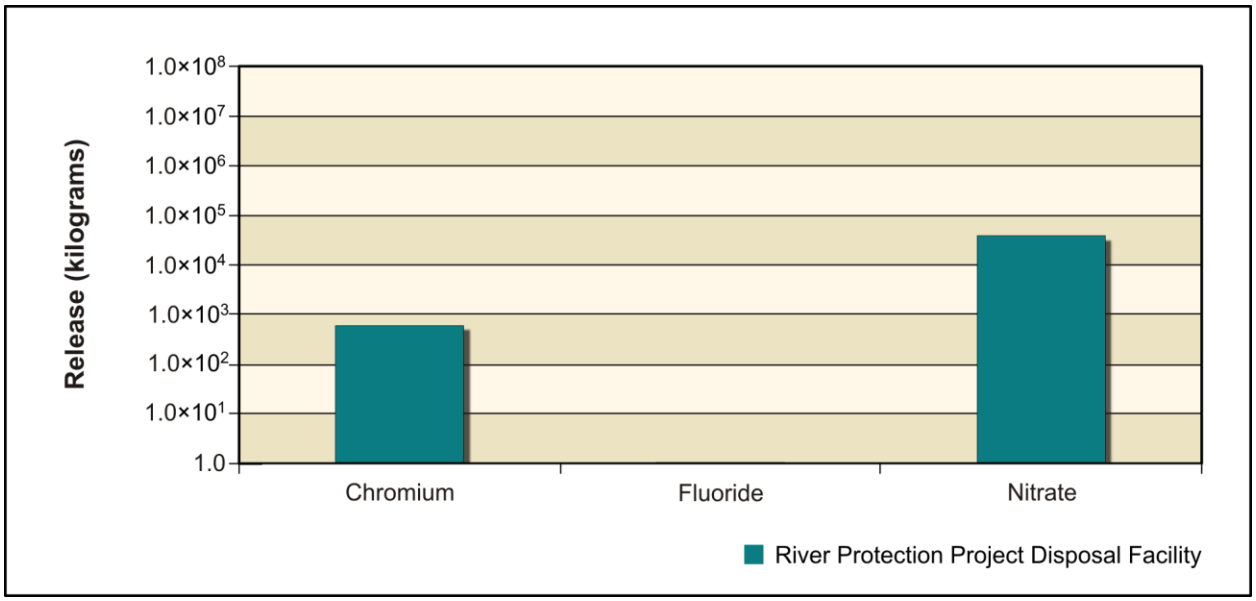


Figure 5–420. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, impacts in terms of groundwater concentration versus time at the RPPDF barrier, IDF-East barrier, Core Zone Boundary, and Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–421 through 5–425). The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

Table 5–95 lists the maximum concentrations of the COPCs in the peak year at IDF-East and the RPPDF, Core Zone Boundary, and Columbia River nearshore. Under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, peak concentrations of technetium-99 and iodine-129 exceed their benchmarks at IDF-East in CY 7629 and CY 7907, respectively. No other constituents exceed their benchmark concentrations under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, during the simulation period.

Figures 5–421 through 5–424 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers). For technetium-99, a small rise in concentration is evident at the RPPDF barrier, Core Zone Boundary, and Columbia River nearshore, peaking around CY 3940 but remaining over an order of magnitude below the benchmark concentration. Beginning around CY 4500, concentrations at the Core Zone Boundary, Columbia River nearshore, and IDF-East barrier begin to increase again. This second peak causes technetium-99 concentrations at the IDF-East barrier to exceed the benchmark by less than an order of magnitude from about CY 6900 to CY 8900. Iodine-129 follows a pattern similar to that of technetium-99, reaching a concentration slightly above the benchmark, while chromium and nitrate concentrations never exceed the benchmark.

Figure 5–425 shows concentration versus time for total uranium. Because of the high retardation of uranium, no contamination appears until after CY 9940, when total uranium concentrations at the Core Zone Boundary first surpass 1.0×10^{-8} micrograms per liter. Total uranium remains over seven orders of magnitude below the benchmark concentration at the Core Zone Boundary throughout the simulation.

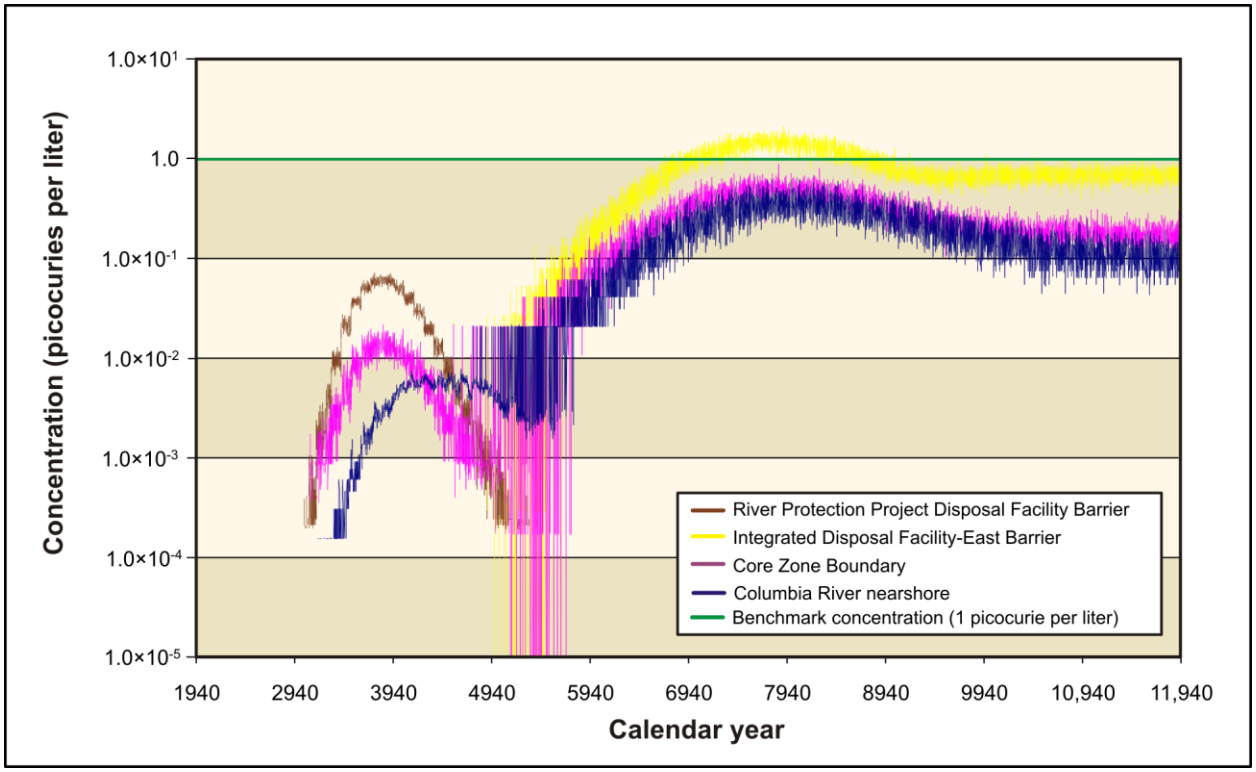


Figure 5–421. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Iodine-129 Concentration Versus Time

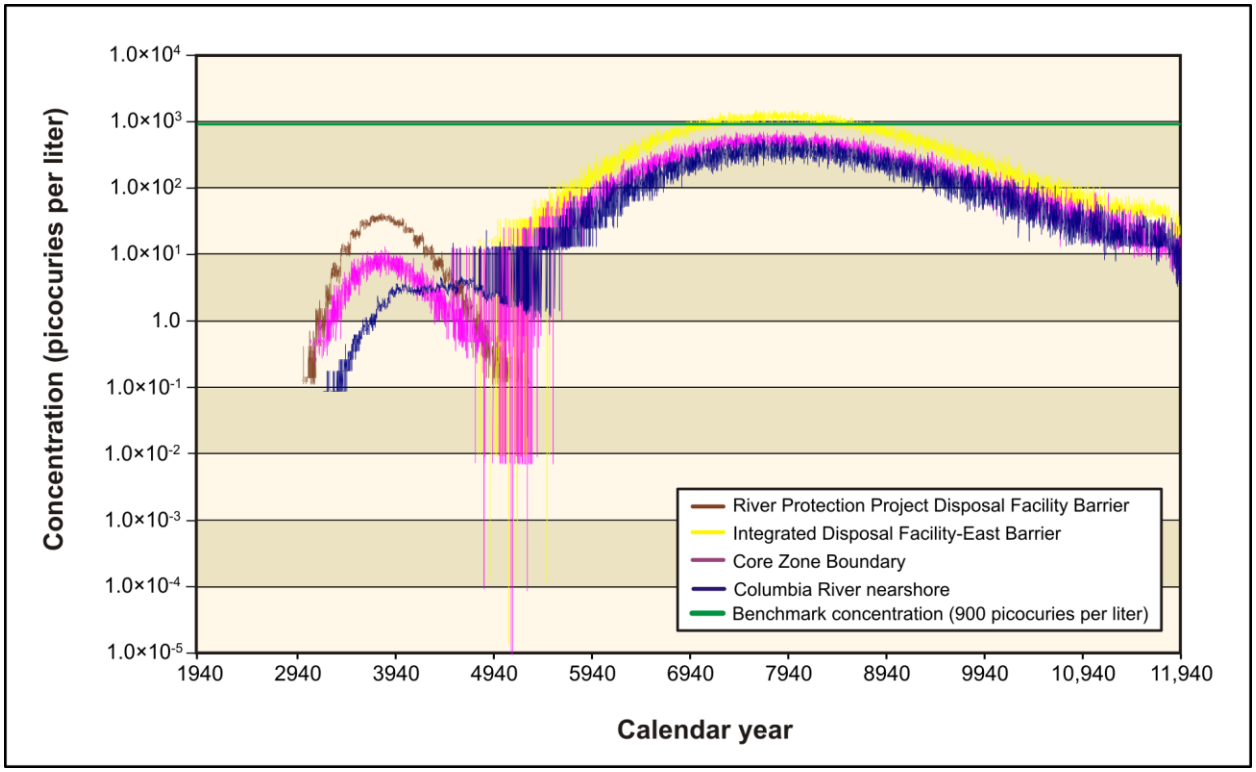


Figure 5–422. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Technetium-99 Concentration Versus Time

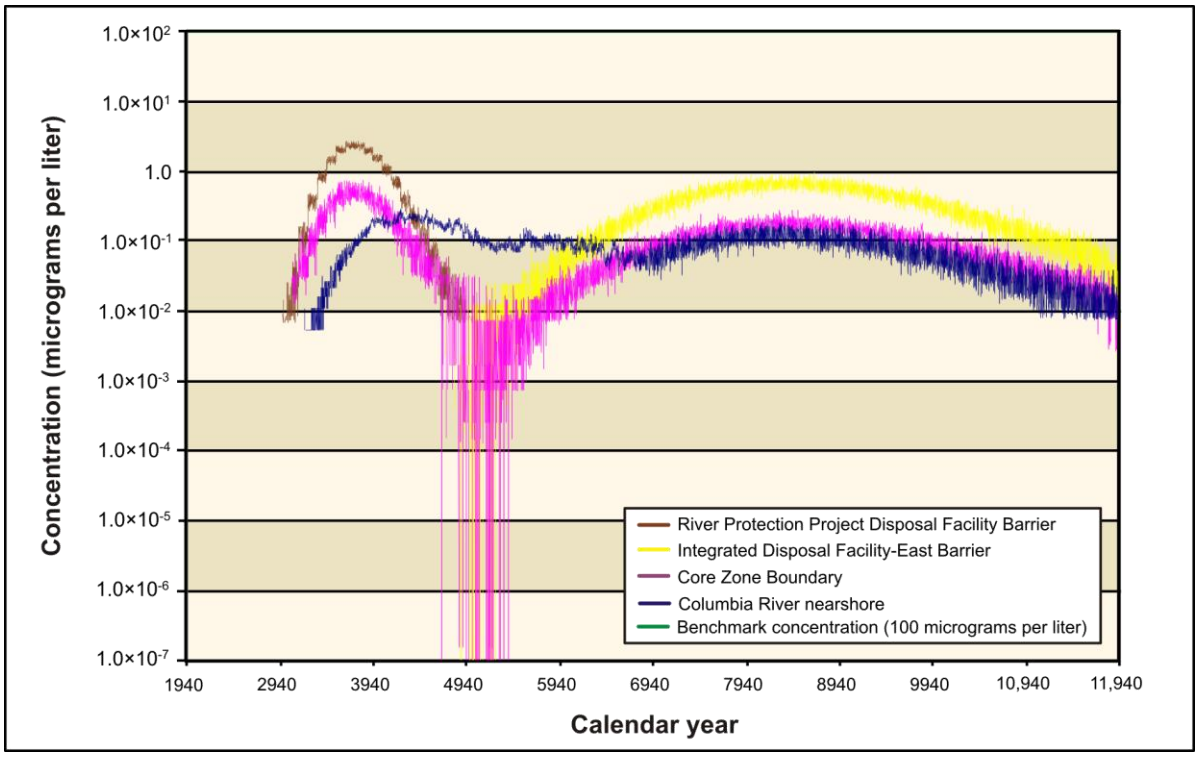


Figure 5–423. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Chromium Concentration Versus Time

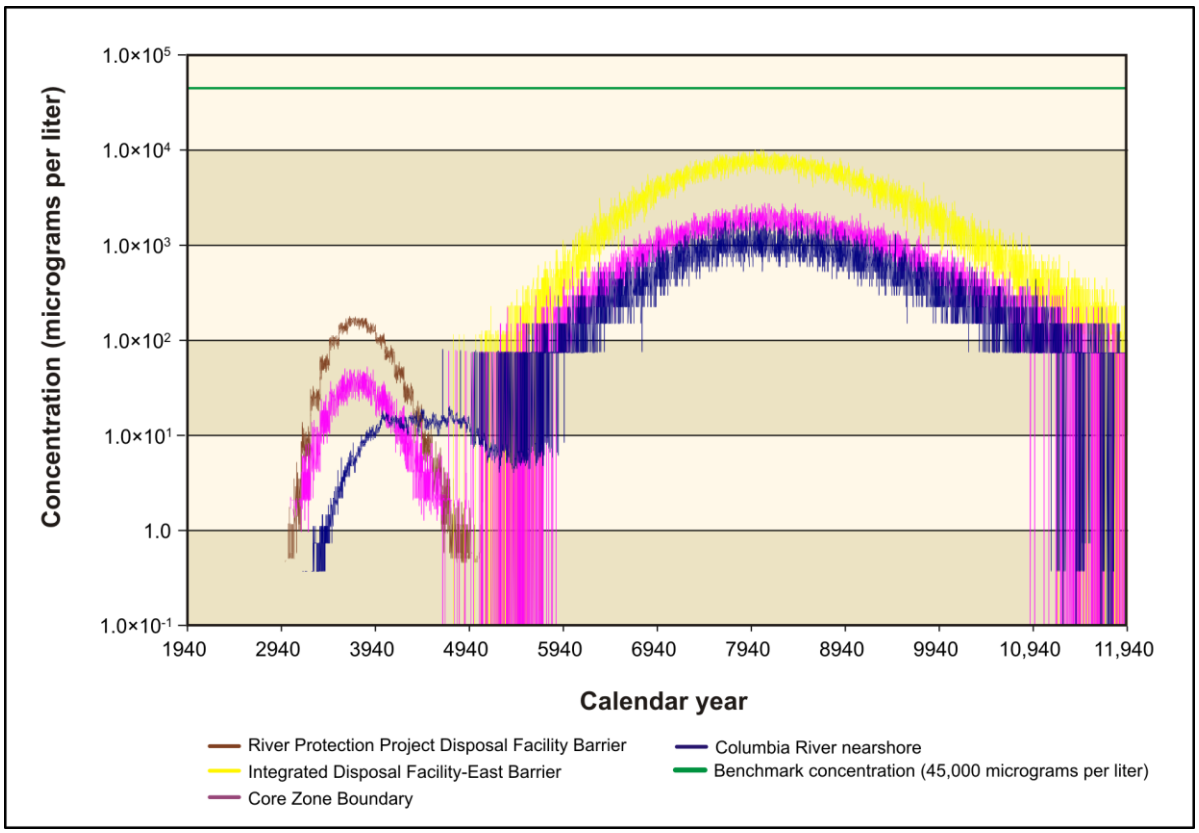


Figure 5–424. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Nitrate Concentration Versus Time

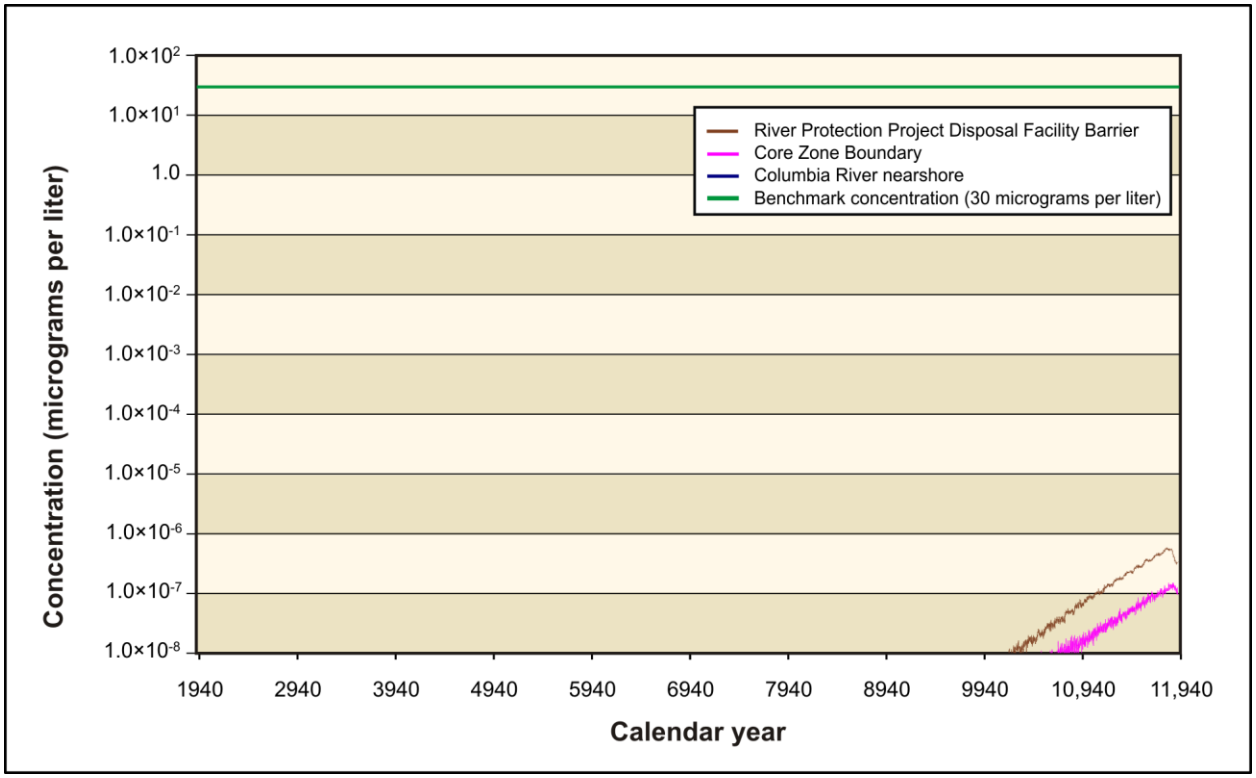


Figure 5–425. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Total Uranium Concentration Versus Time

Table 5–95. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Maximum COPC Concentrations in the Peak Year at IDF-East and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)					
Technetium-99	**1,540** (7629)	42 (3818)	748 (7848)	608 (8014)	900
Iodine-129	**2.1** (7907)	0.1 (3747)	0.9 (7856)	0.6 (7796)	1
Chemical (micrograms per liter)					
Chromium	1 (8691)	3 (3740)	1 (3846)	0 (4250)	100
Nitrate	10,300 (8052)	180 (3670)	2,790 (8095)	2,210 (7940)	45,000

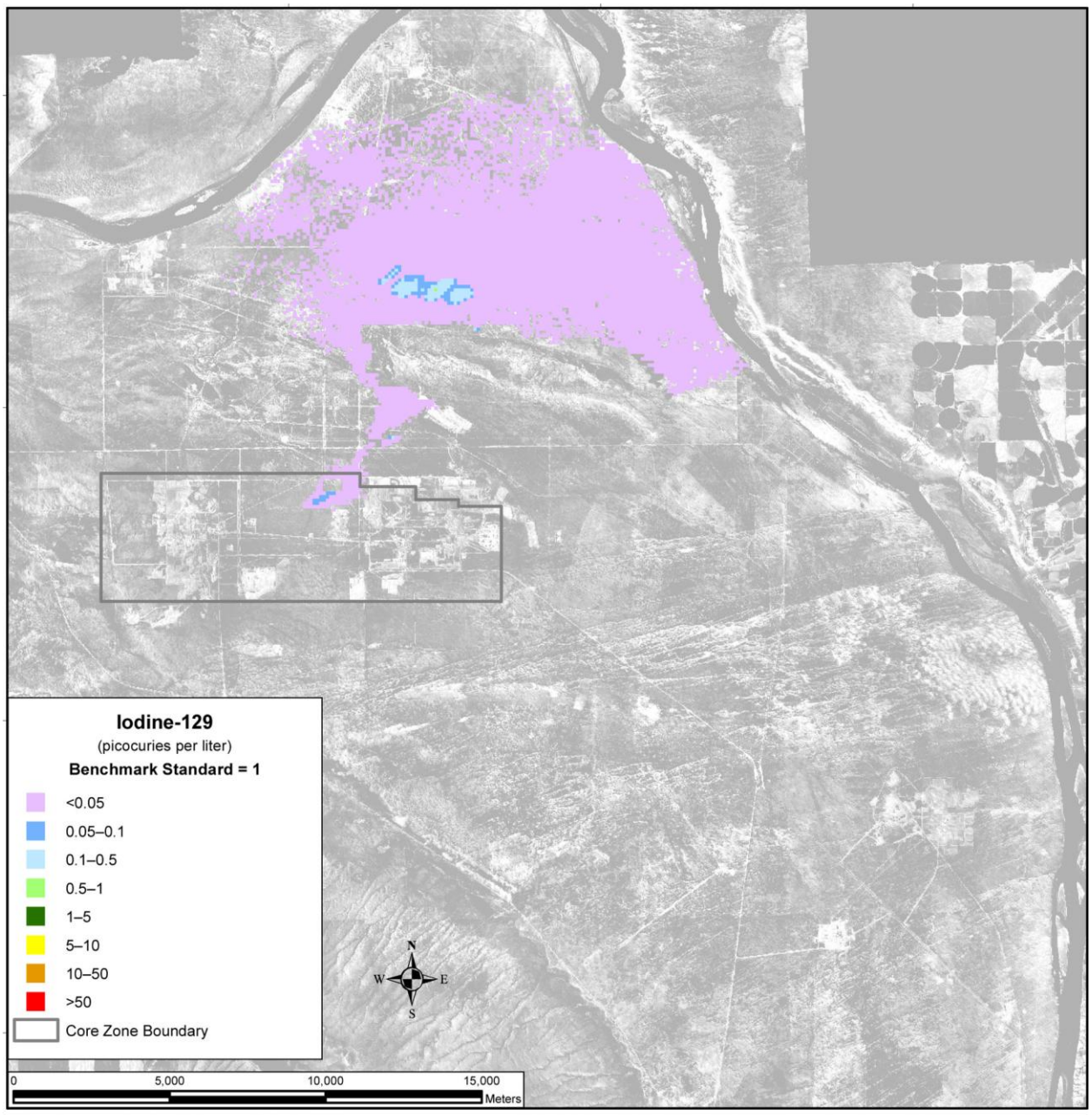
Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

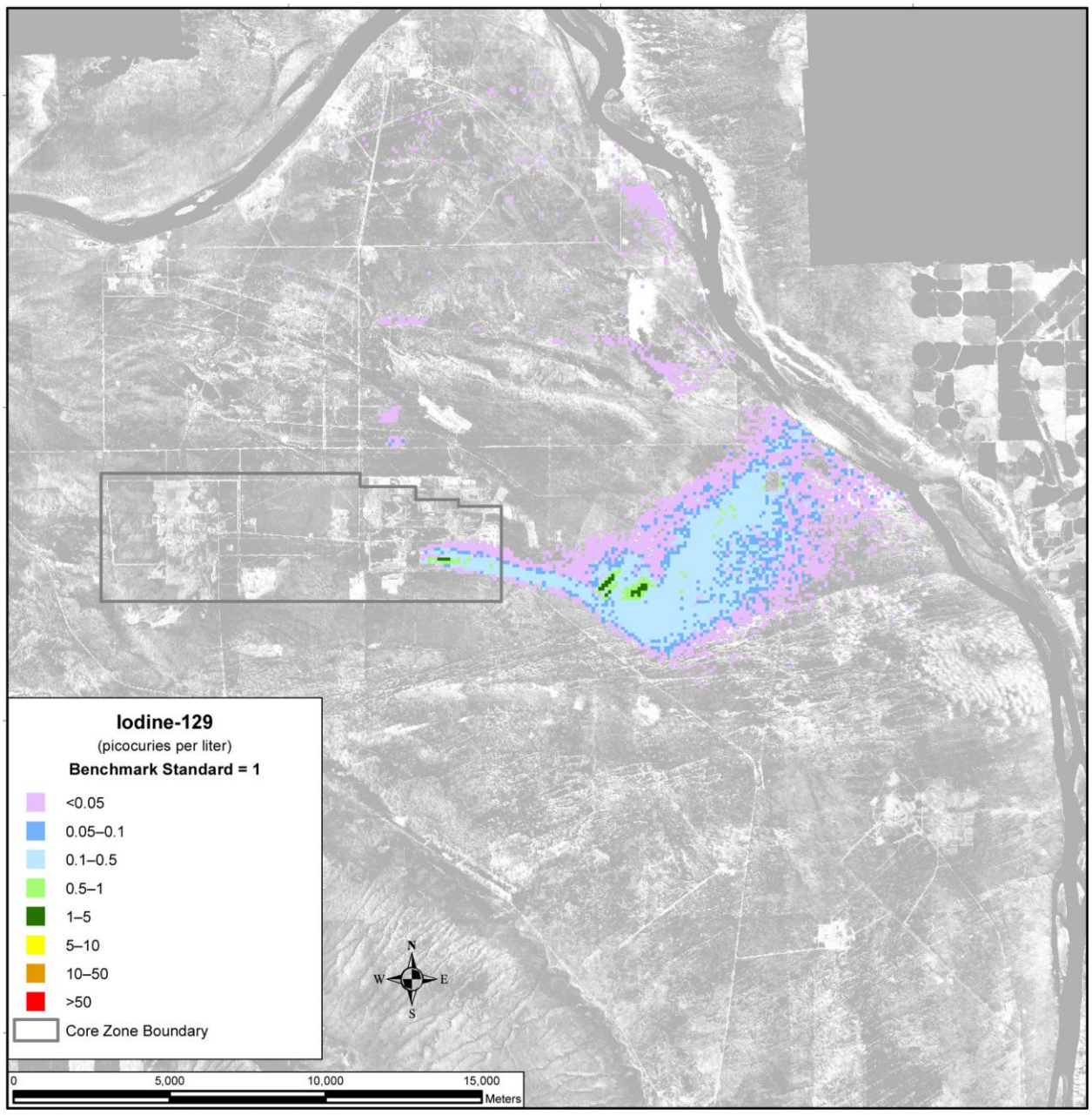
This section presents the impacts of Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–426 through 5–437). Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

In CY 3890 (see Figure 5–426), there is a low-concentration plume of iodine-129 that stretches north from the RPPDF through Gable Gap. By CY 7140 (see Figure 5–427), the plume from the RPPDF has attentuated, but a new plume has formed, traveling east from IDF-East. Peak concentrations in this plume are up to five times greater than the benchmark concentration. Figure 5–428 shows the iodine-129 concentration distribution in CY 11,885; the plume continues to spread toward the river, while the concentrations within it remain relatively the same. Technetium-99 (see Figures 5–429 through 5–431), chromium (see Figures 5–432 through 5–434), and nitrate (see Figures 5–435 through 5–437) show similar spatial distributions, with lower concentrations at selected times. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., move at the rate of the pore-water velocity). Iodine-129 and technetium-99 are the only conservative tracers to have values over their benchmark concentrarions from the plume originating in IDF-East. No appreciable concentrations of total uranium result in contaminant plumes under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, so figures of plume maps for total uranium are not shown.



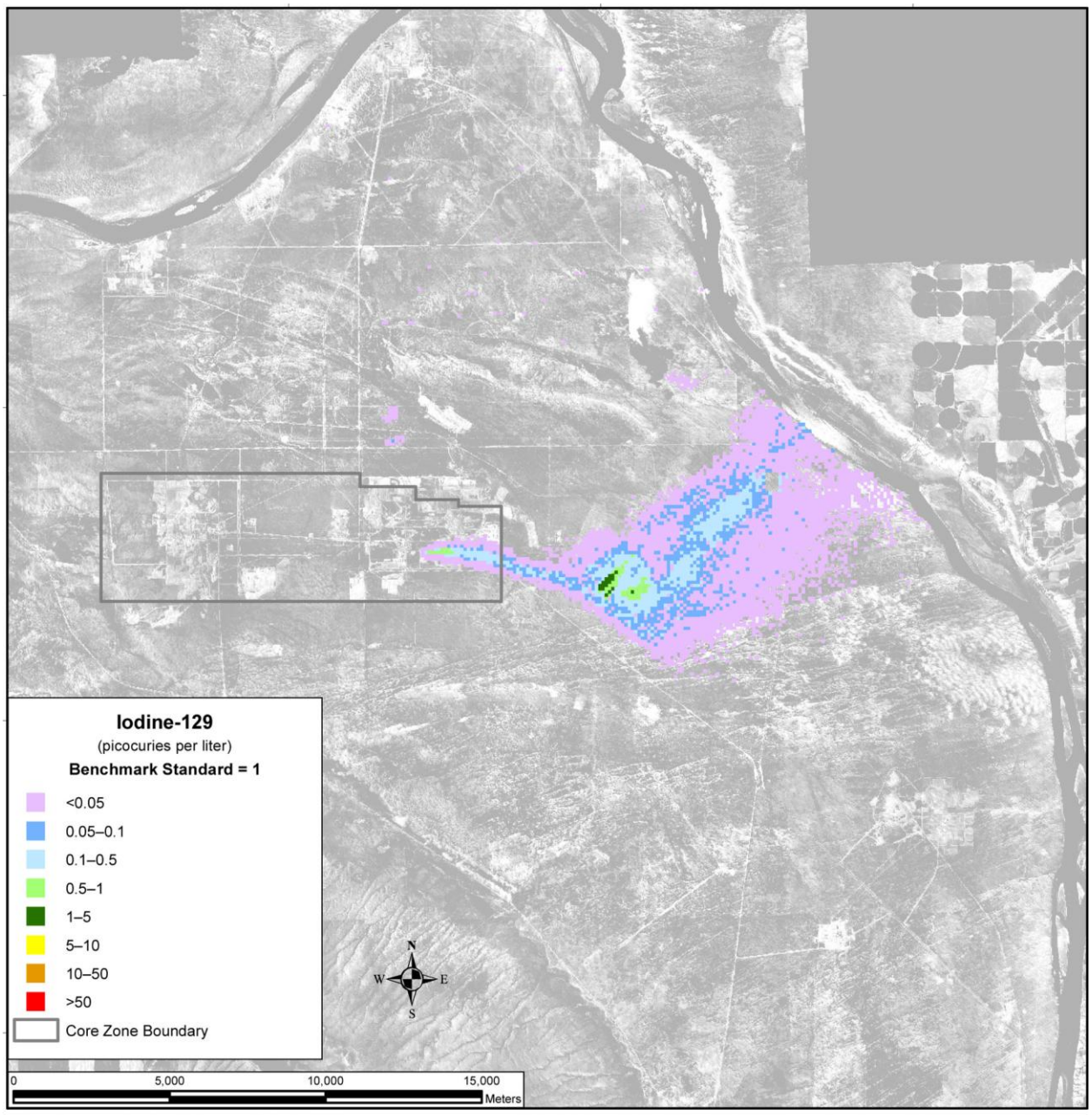
Note: To convert meters to feet, multiply by 3.281.

Figure 5–426. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



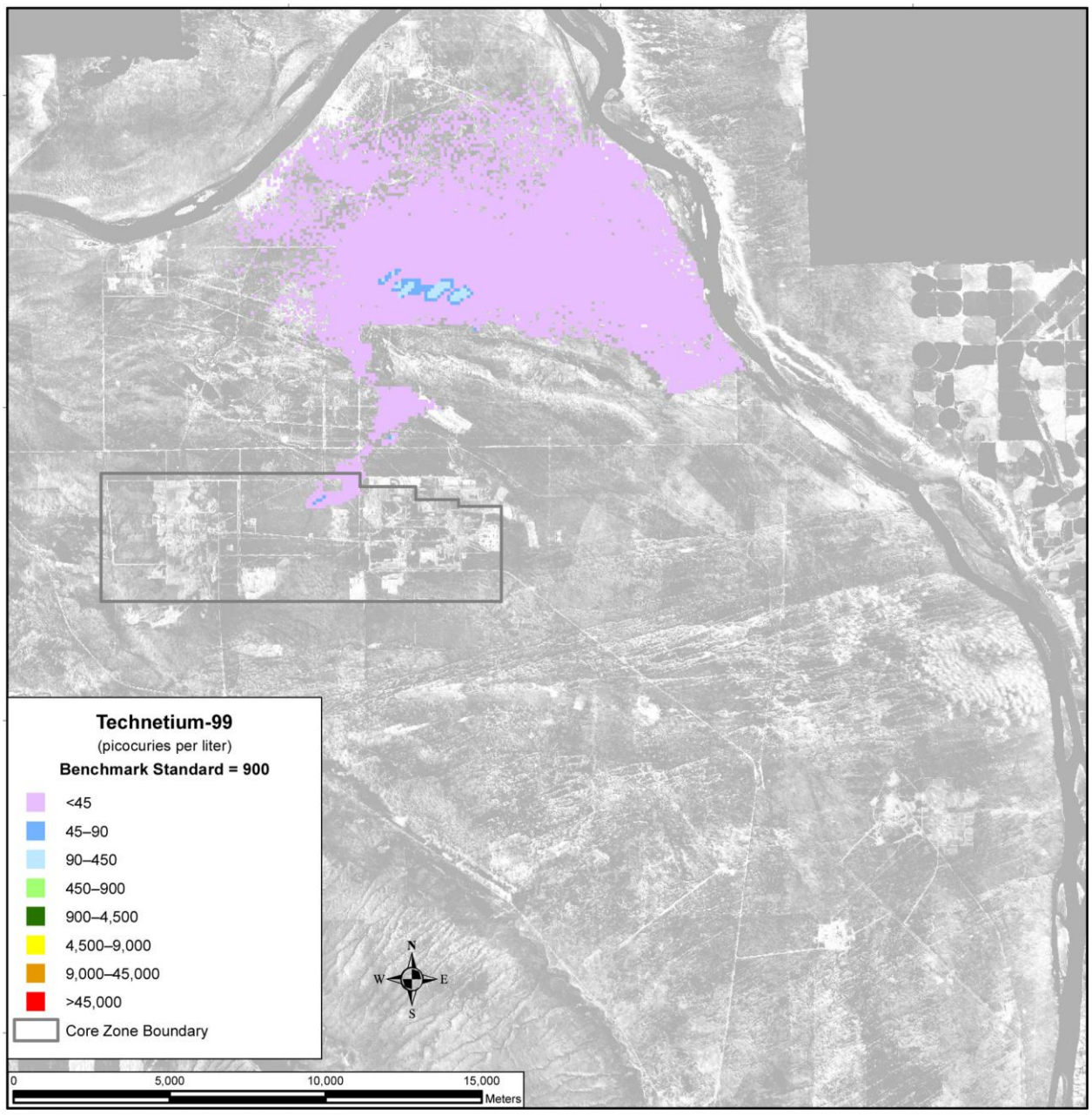
Note: To convert meters to feet, multiply by 3.281.

Figure 5–427. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



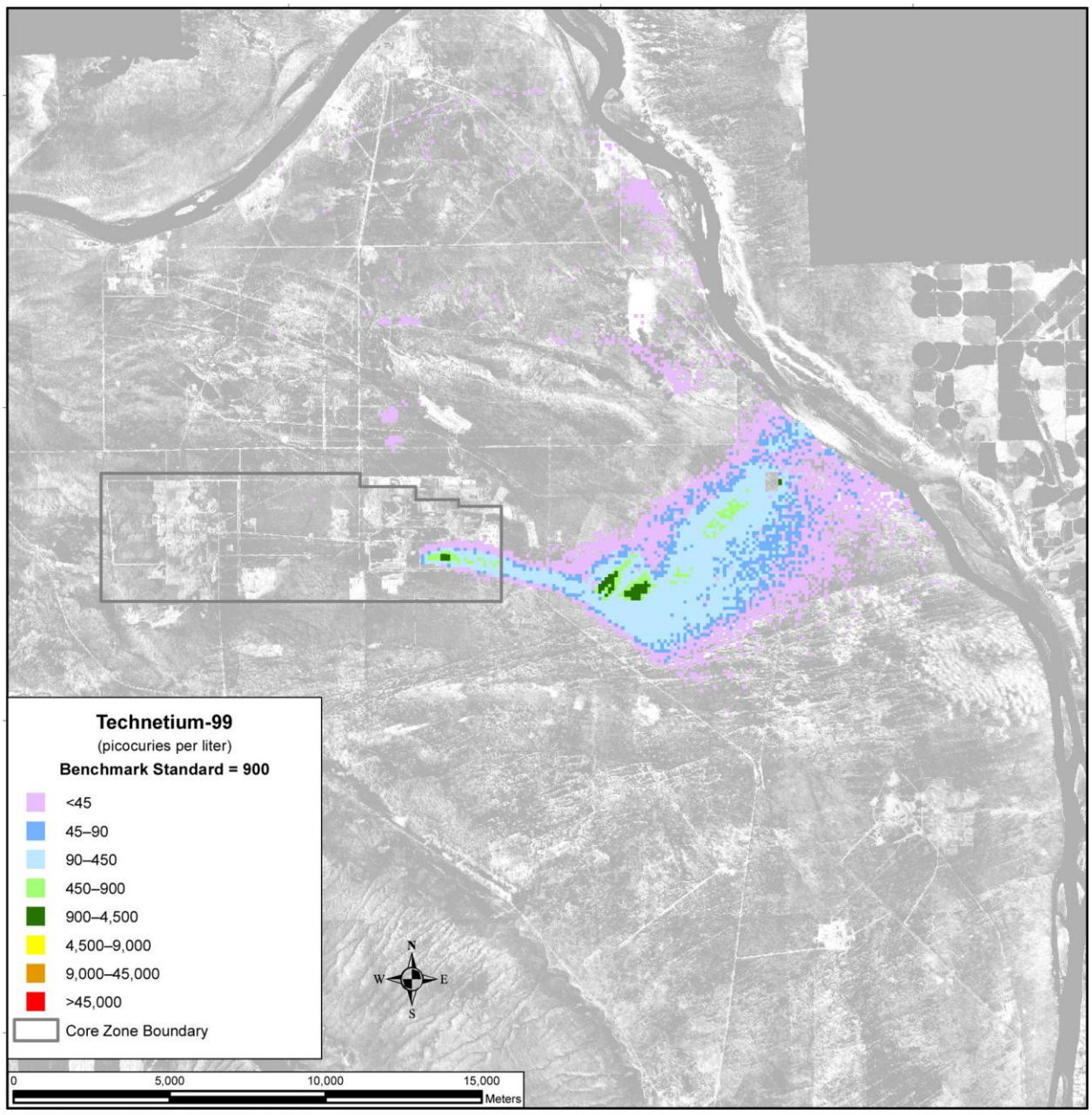
Note: To convert meters to feet, multiply by 3.281.

Figure 5–428. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



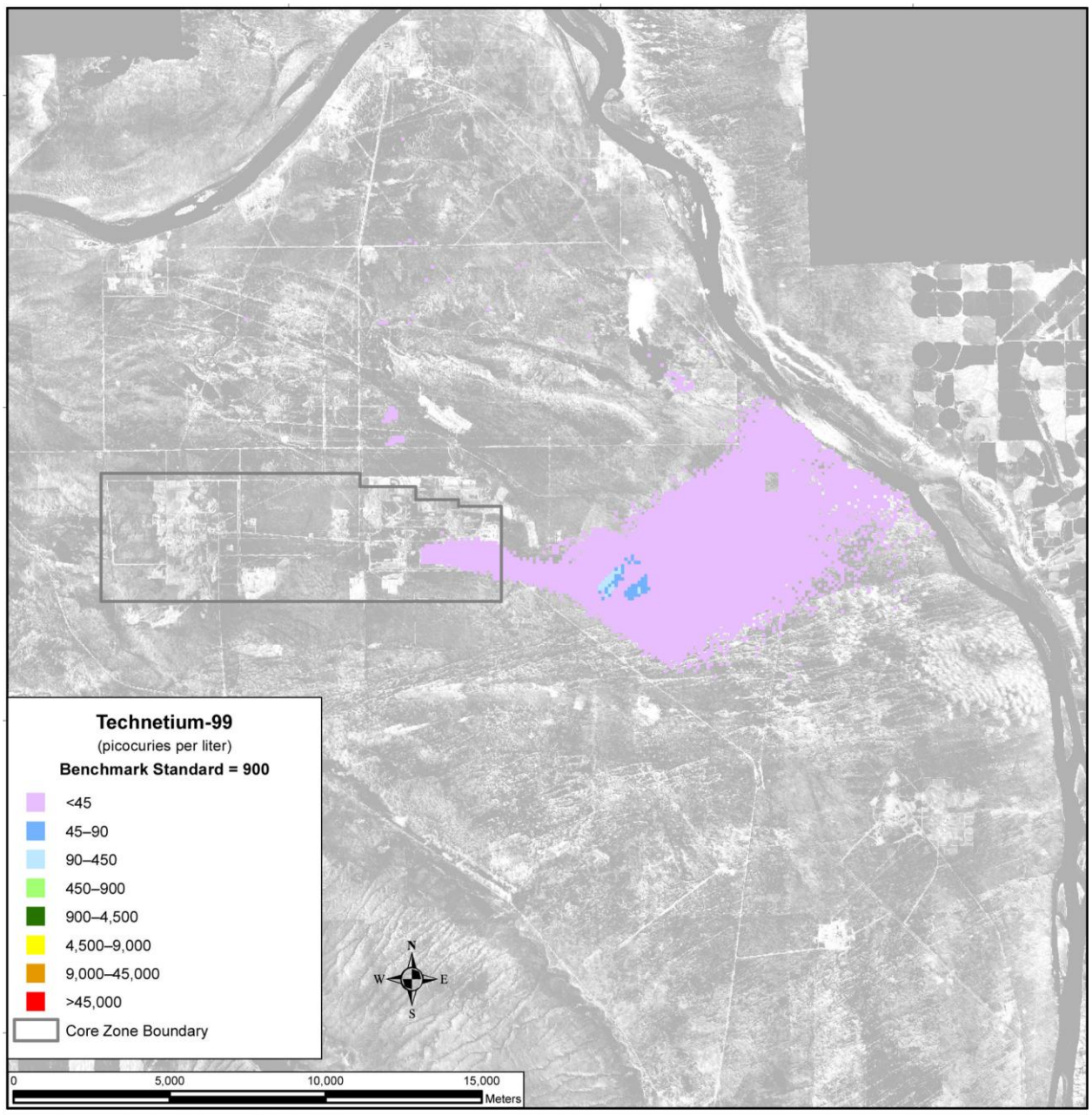
Note: To convert meters to feet, multiply by 3.281.

Figure 5–429. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



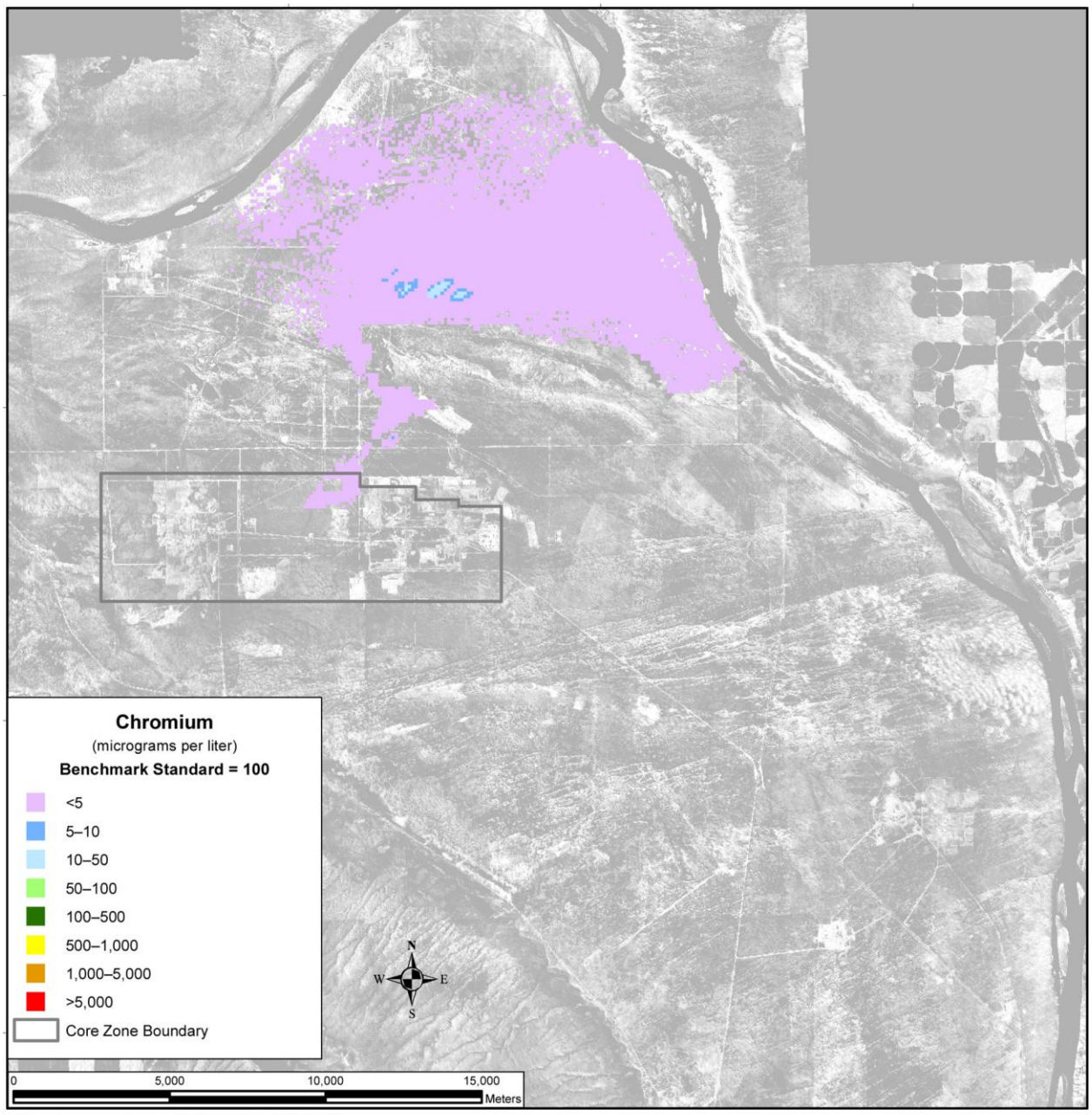
Note: To convert meters to feet, multiply by 3.281.

Figure 5–430. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



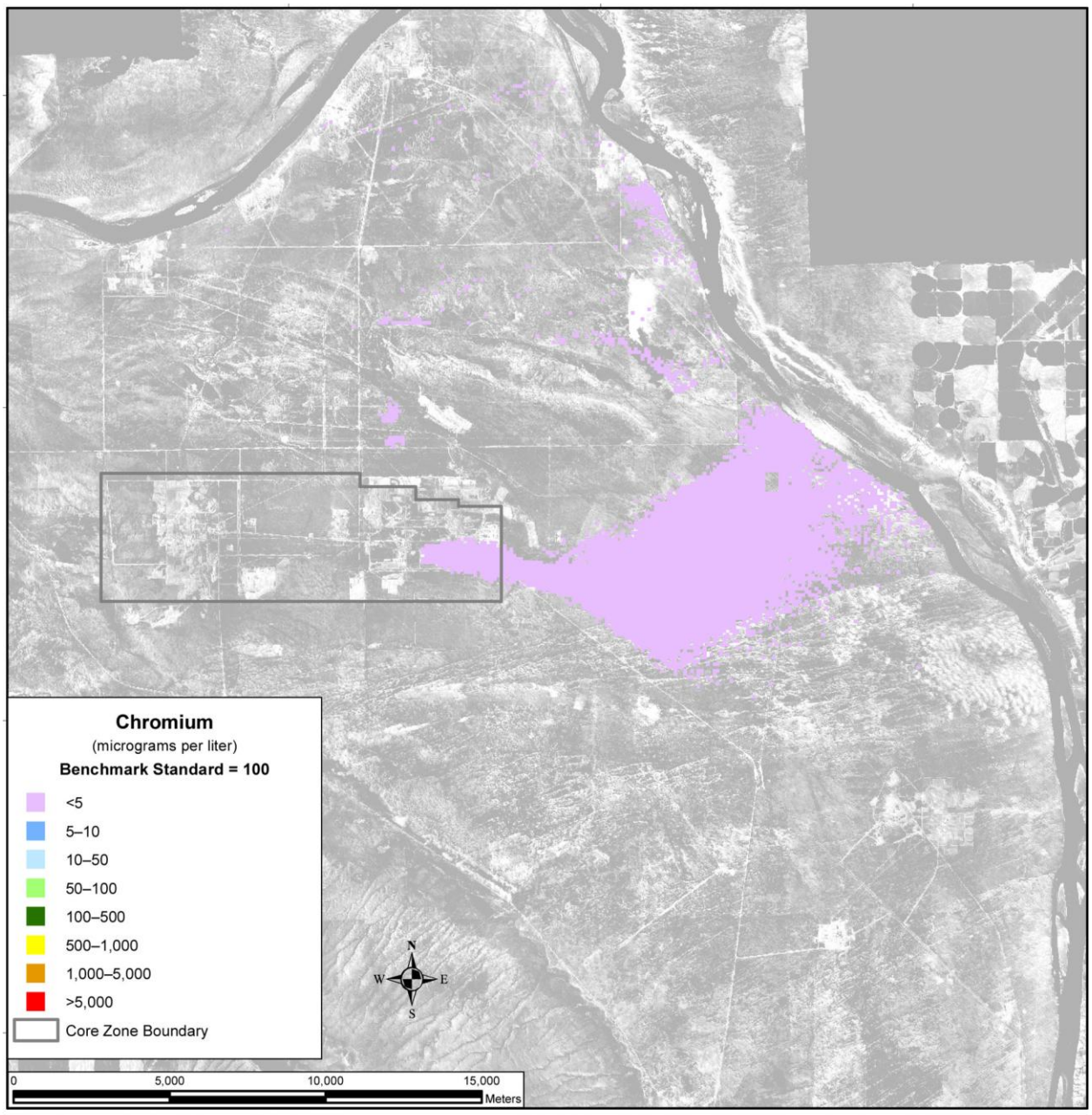
Note: To convert meters to feet, multiply by 3.281.

Figure 5–431. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



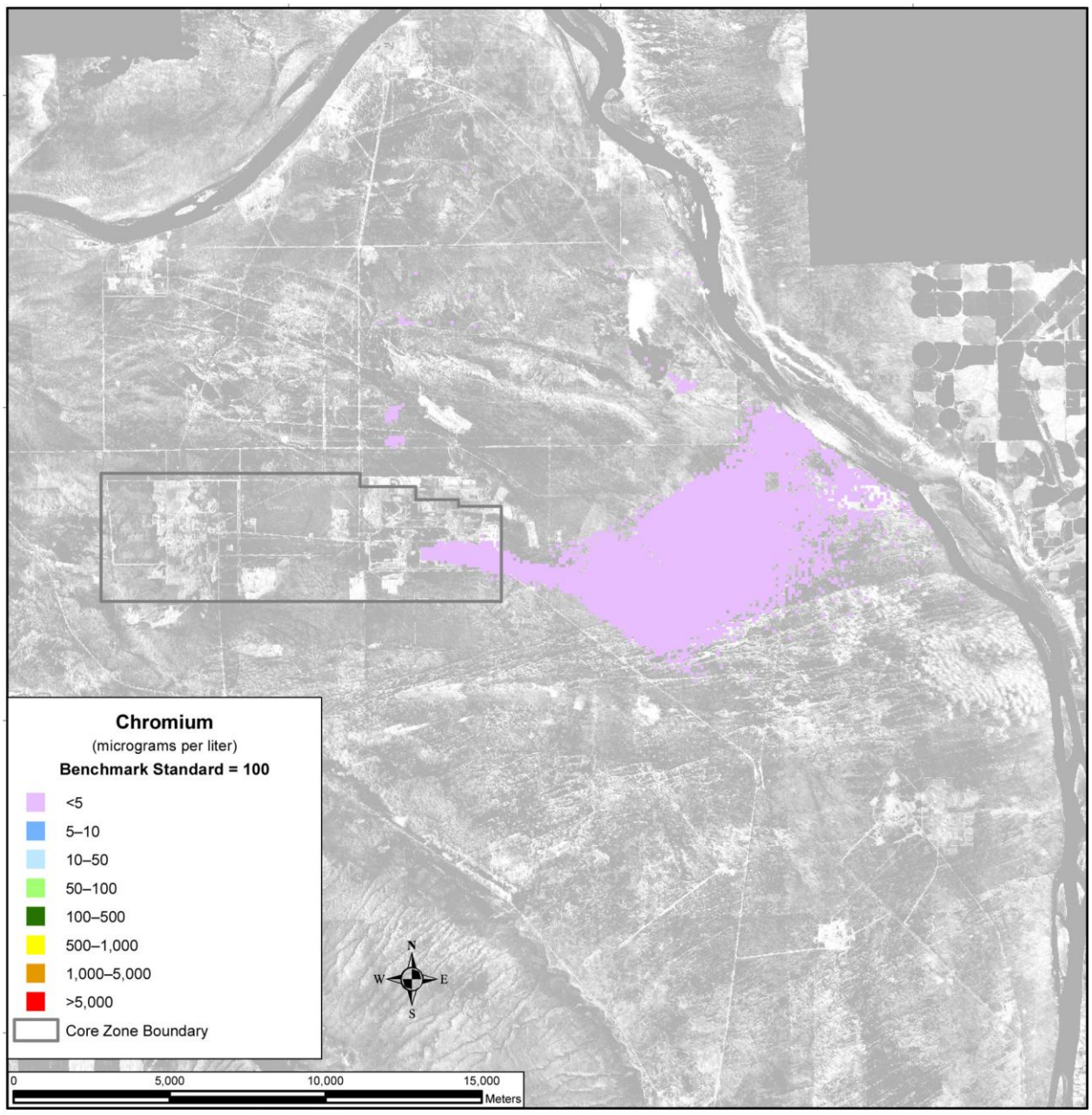
Note: To convert meters to feet, multiply by 3.281.

Figure 5–432. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



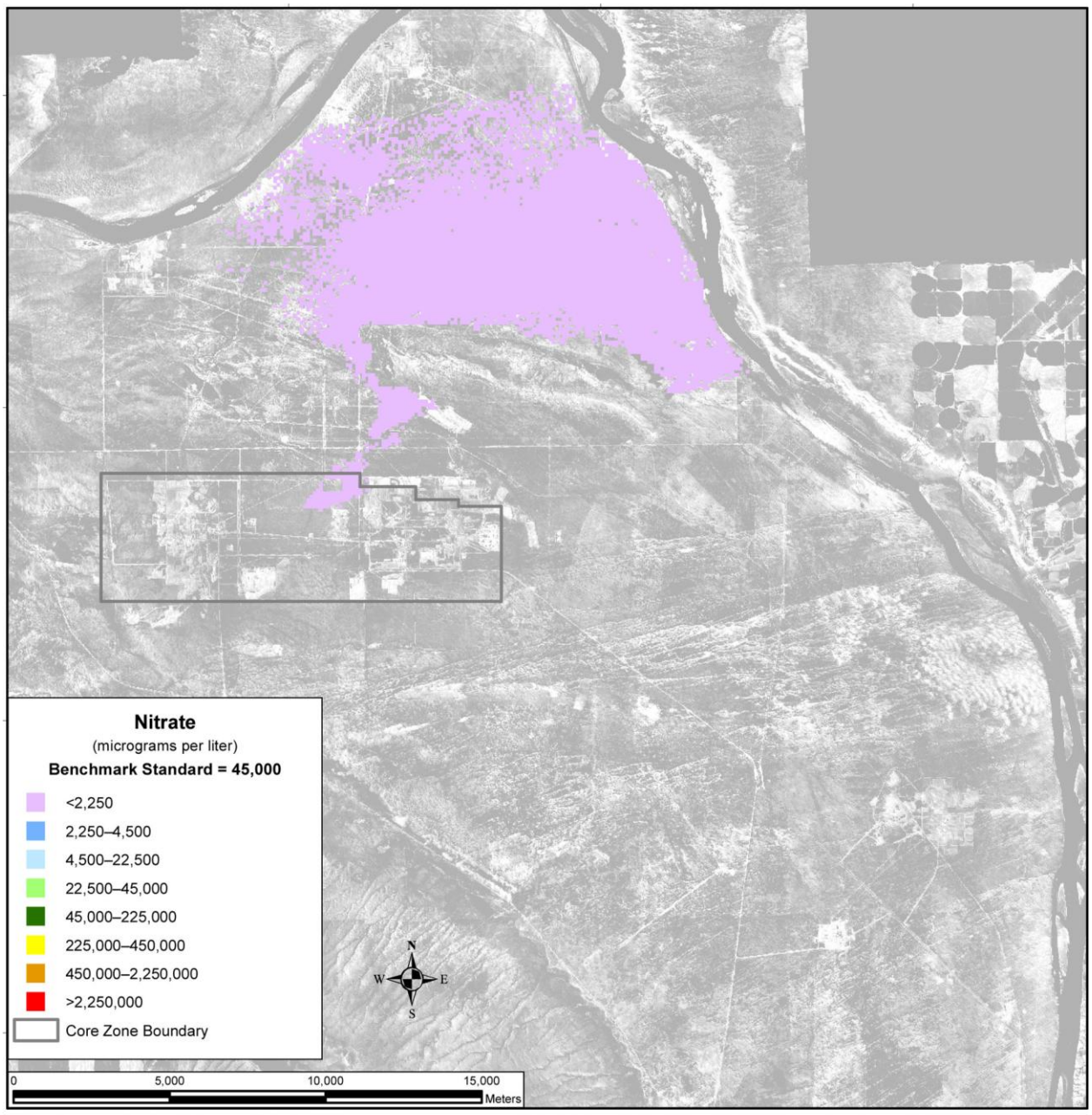
Note: To convert meters to feet, multiply by 3.281.

Figure 5–433. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



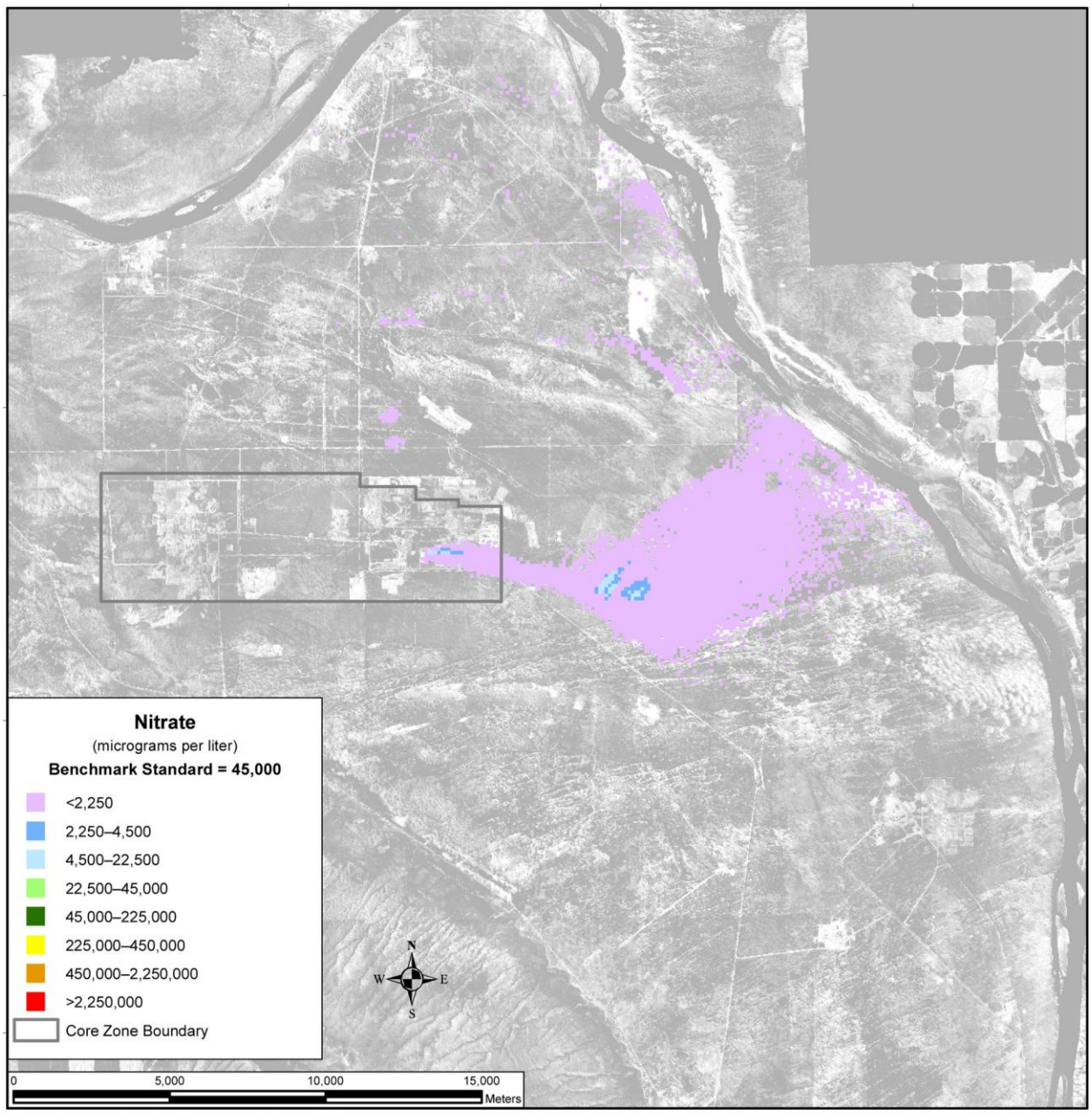
Note: To convert meters to feet, multiply by 3.281.

Figure 5–434. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



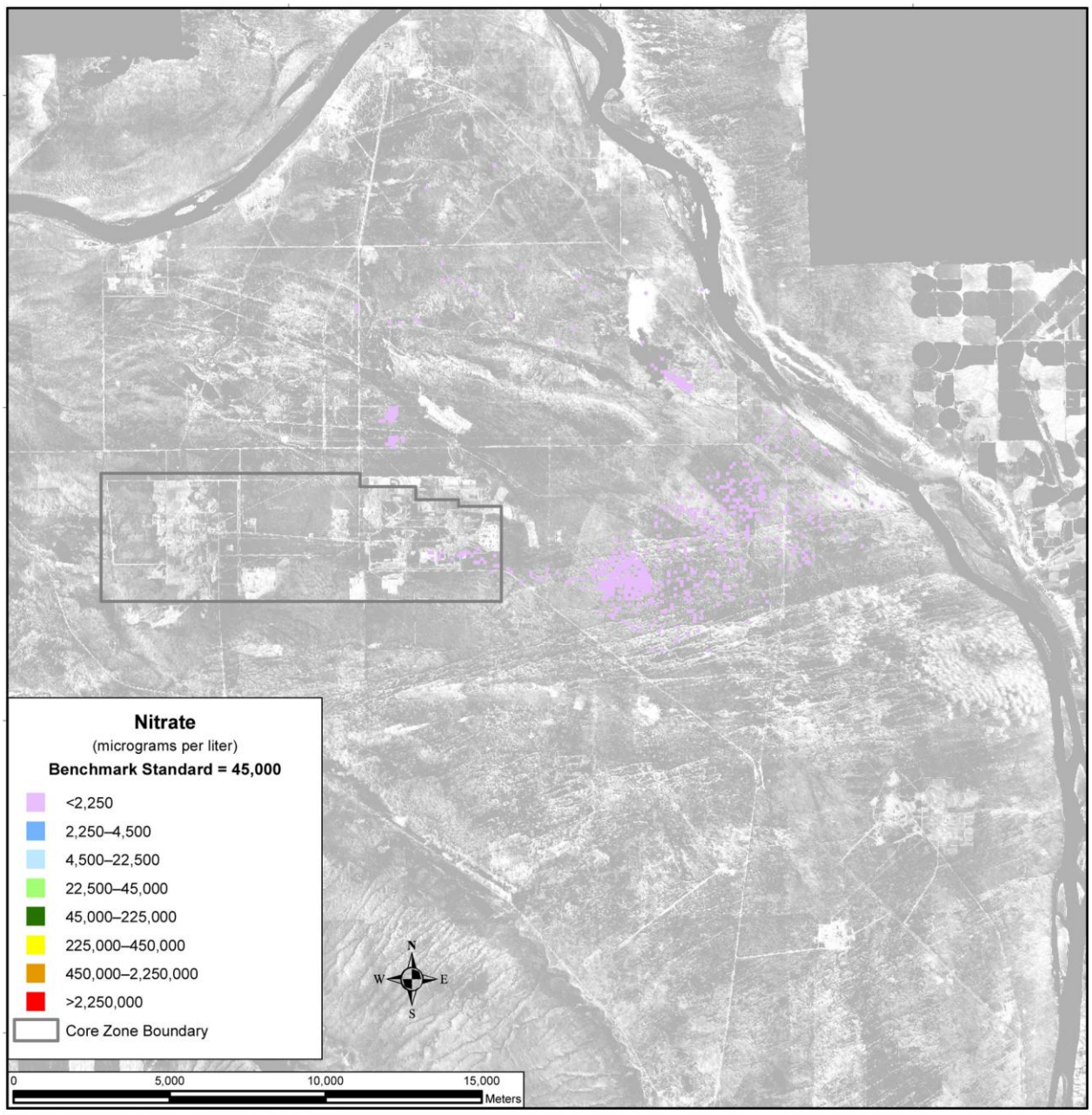
Note: To convert meters to feet, multiply by 3.281.

Figure 5–435. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–436. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–437. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, in general, discharges from IDF-East are the predominant contributors. The RPPDF is a secondary contributor.

For the conservative tracers, technetium-99 and iodine-129 are the only constituents to exceed the benchmark at the IDF-East barrier from around CY 6940 to CY 8940. Nitrate and chromium show similar concentration curves but never exceed their respective benchmarks.

For total uranium, limited mobility is an important factor governing the timeframes and scale of groundwater impacts. The concentrations of this retarded species remain seven orders of magnitude

below the benchmark at the Core Zone Boundary and the Columbia River nearshore throughout the simulation.

5.3.1.2.1.3 Disposal Group 1, Subgroup 1-C

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Disposal Group 1, Subgroup 1-C, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 3B and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Waste would be converted to IHLW, ILAW glass, and cast stone waste. IHLW would be stored on site, while ILAW glass and cast stone waste would be disposed of in IDF-East.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and the RPPDF in CY 2009 and continue through CY 2050, when these facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in the facilities would become available for release to the environment, and modified RCRA Subtitle C barriers would be emplaced over IDF-East and the RPPDF to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C. Complete results for all 40 COPCs are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129, technetium-99, and uranium-238
- Chemical risk drivers: none
- Chemical hazard drivers: acetonitrile, boron, chromium, fluoride, nitrate, and total uranium

The COPC drivers for Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. Uranium-238 and total uranium were added to the COPC drivers; although their contribution to risk and hazard are not dominant during the year of peak risk or hazard, they become major contributors toward the end of the period of analysis. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for 100 percent of the chemical hazard associated with Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C.

The COPC drivers that are discussed in detail in this section fall into two categories. Iodine-129, technetium-99, acetonitrile, boron, chromium, and nitrate are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. Uranium-238 and total uranium are long-lived, or stable, but are not as mobile as the other COPC drivers. These constituents move about seven times more slowly than groundwater. As

the analyses of release, concentration versus time, and spatial distribution of the COPC drivers are presented, the distinct behavior of these groups will become apparent.

The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, in terms of the total amount of COPCs released to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms (see Figures 5–438 through 5–449). Eight subtotals are plotted, representing releases from ILAW glass, cast stone waste, ETF-generated secondary waste, retired melters, tank closure secondary waste, FFTF Decommissioning Alternative 3 waste, waste management secondary waste, onsite and offsite waste, and RPPDF waste. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over eight orders of magnitude within the same series of figures.

Figure 5–438 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–439, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). The predominant source of chromium, nitrate, and technetium-99 is the cast stone waste; that of iodine-129 is offsite waste. Other sources of contamination include ILAW glass, ETF-generated secondary waste, retired melters, tank closure secondary waste, FFTF Decommissioning Alternative 3 waste, waste management secondary waste, and onsite waste.

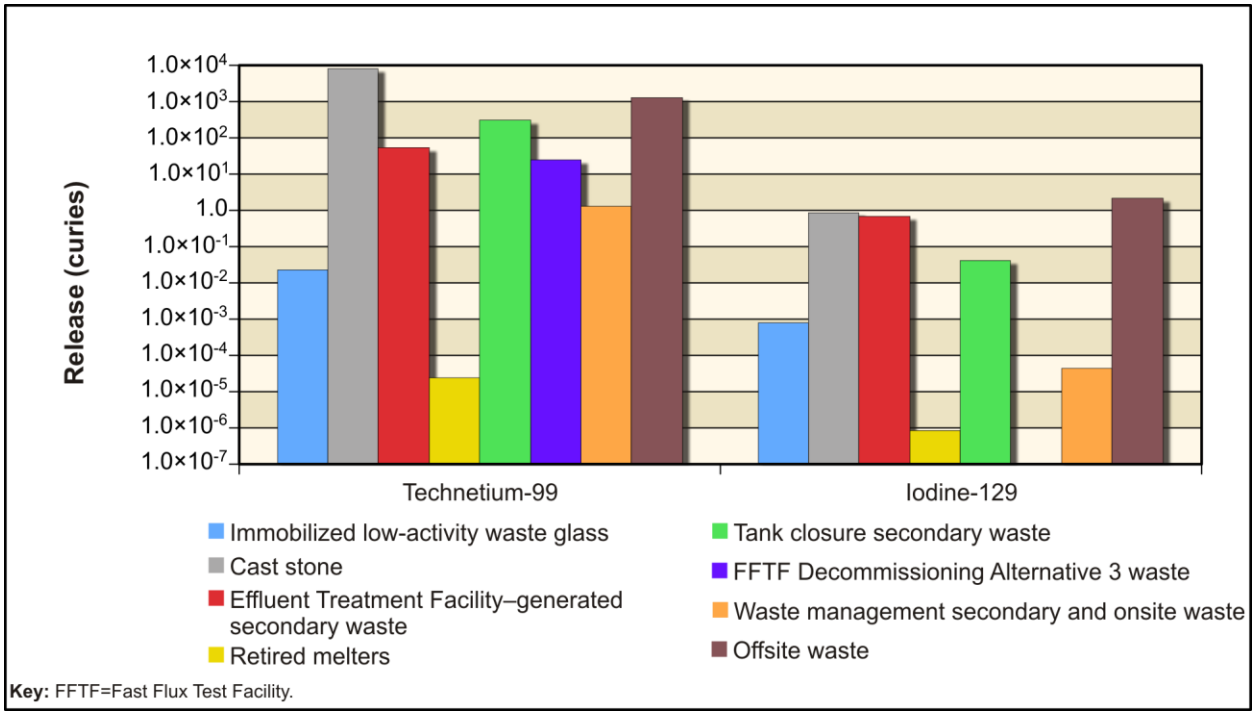


Figure 5–438. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

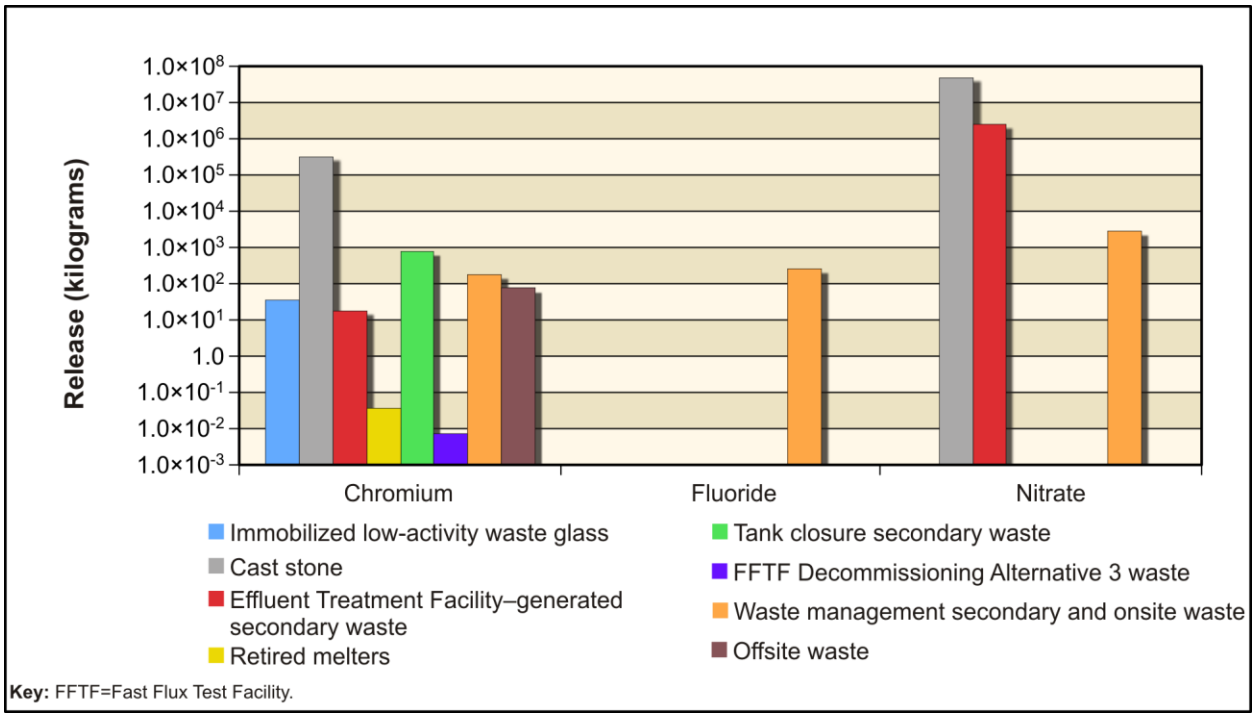


Figure 5–439. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–440 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–441, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Nearly all of the COPC drivers contained in offsite waste released to the vadose zone reach groundwater during the period of analysis, but only 53 to 76 percent of the total inventory of technetium-99 and iodine-129 released to the vadose zone reaches groundwater. Chromium from ILAW glass and retired melters behaves similarly to technetium-99 and iodine-129. When released from other sources, nearly all the chromium that enters the vadose zone reaches groundwater. For nitrate and fluoride, nearly 100 percent of the inventory released to the vadose zone reaches groundwater.

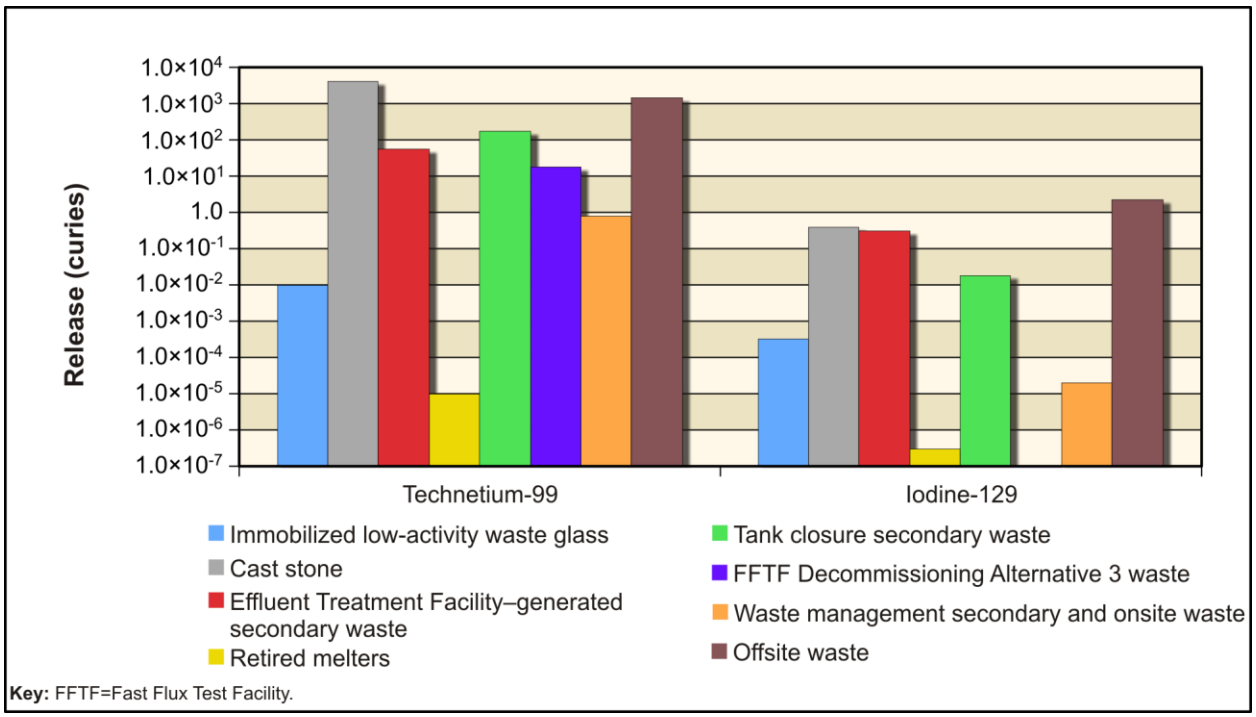


Figure 5–440. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

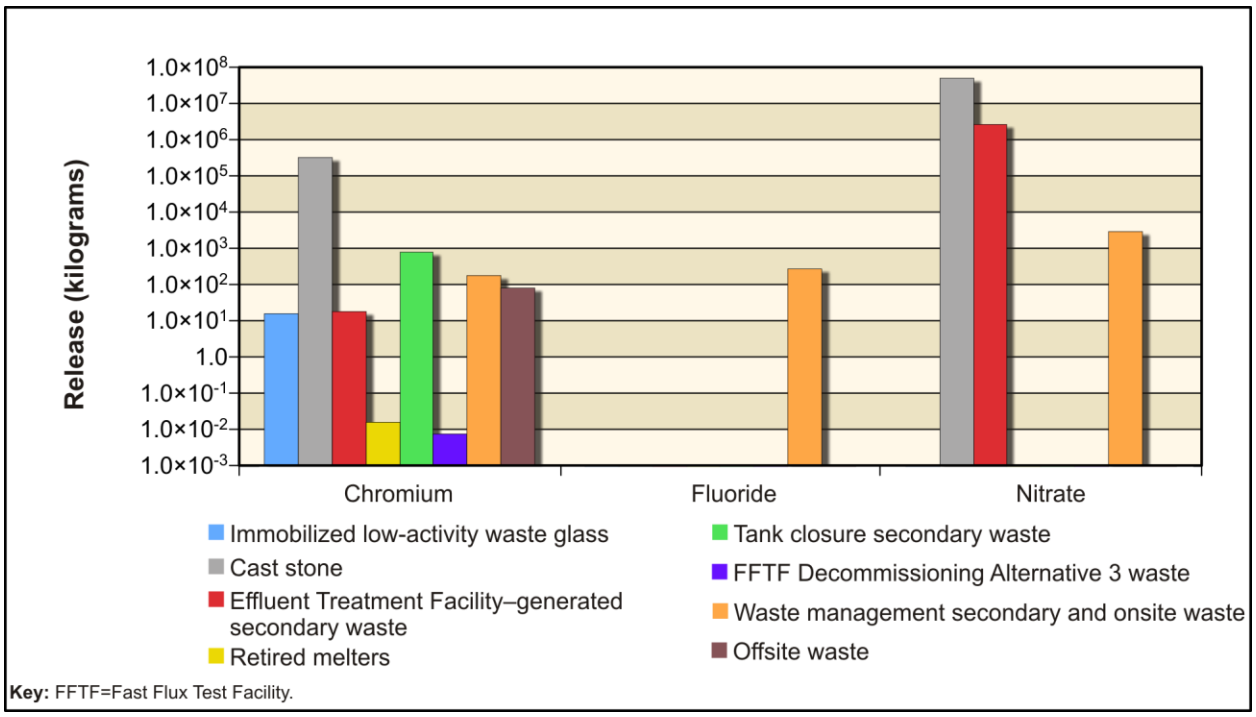


Figure 5–441. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–442 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–443, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In nearly all cases, between 90 and 100 percent of the

amount released to groundwater reaches the Columbia River in the analysis. The exceptions to this trend are the retired melters for both technetium-99 and iodine-129 and waste management secondary and onsite waste for iodine-129. In these cases, none of the inventory released to groundwater reaches the Columbia River.

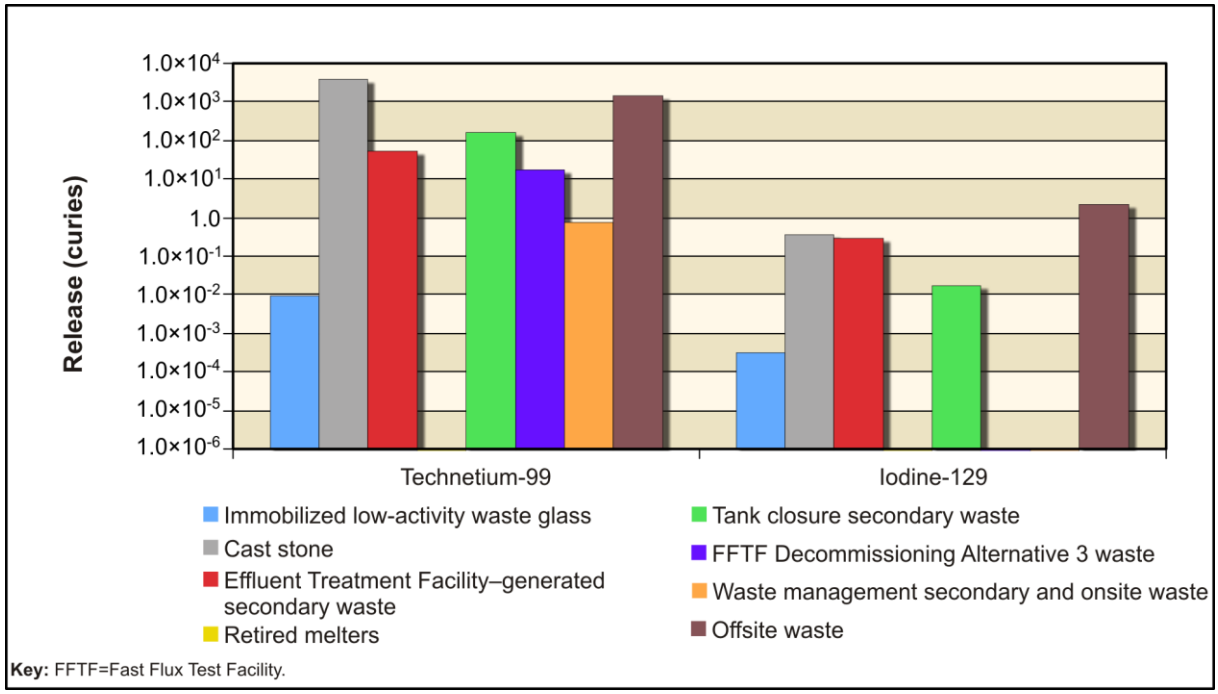


Figure 5–442. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

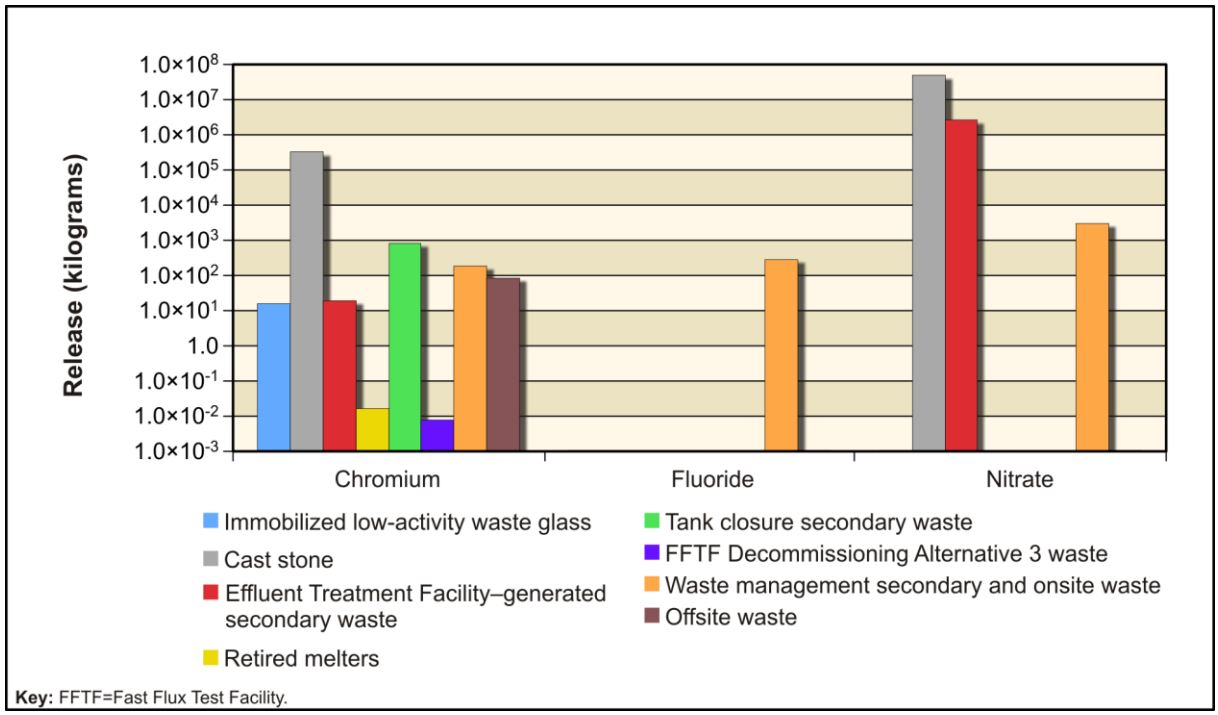


Figure 5–443. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

Figure 5–444 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–445, the chemical hazard drivers. For all types of sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, and nitrate are all present at the RPPDF.

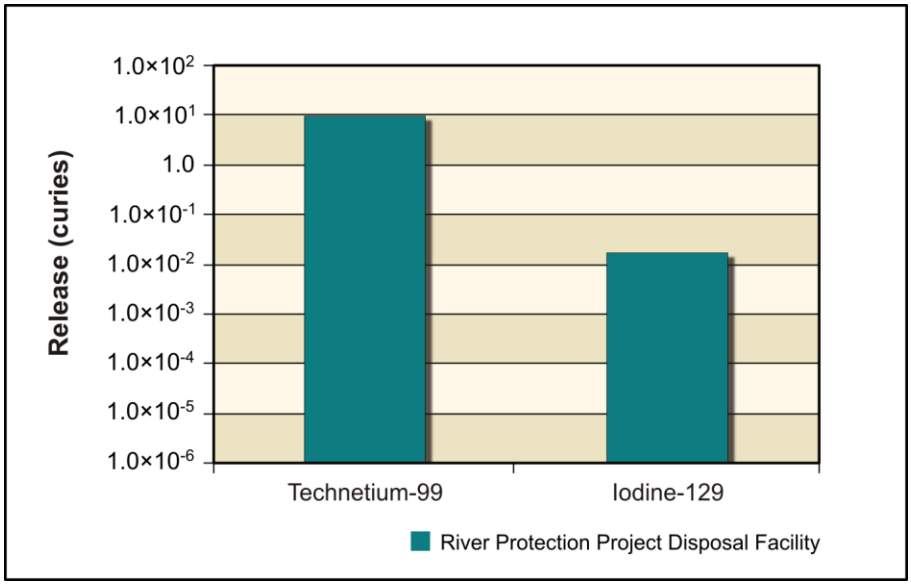


Figure 5–444. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

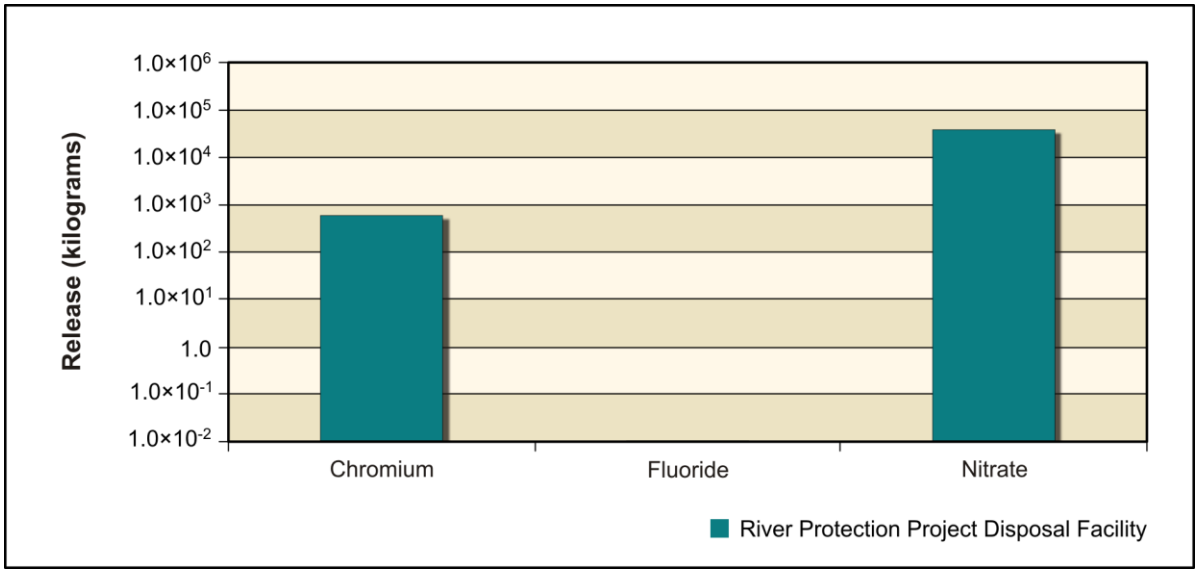


Figure 5–445. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–446 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–447, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present at the RPPDF behave as conservative tracers, with essentially all of the mass released to the vadose zone reaching groundwater.

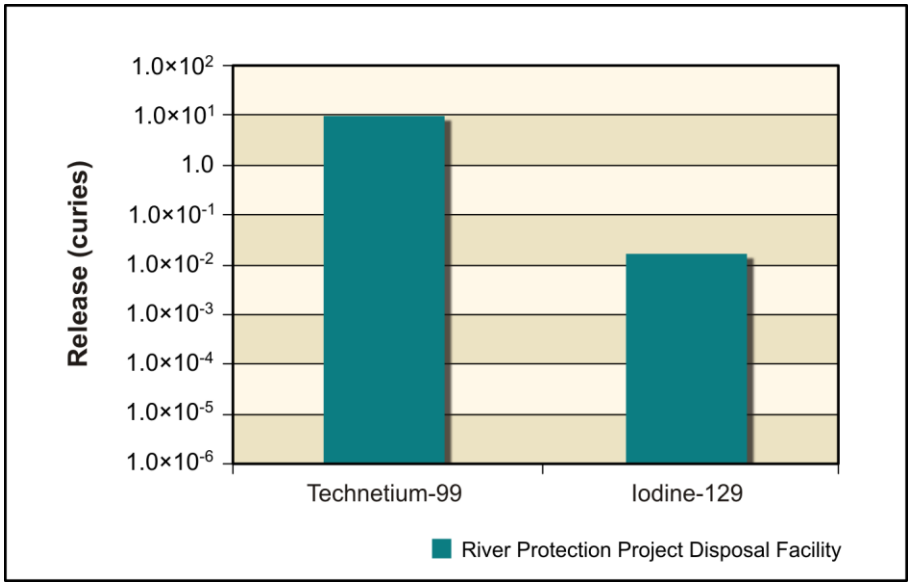


Figure 5–446. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

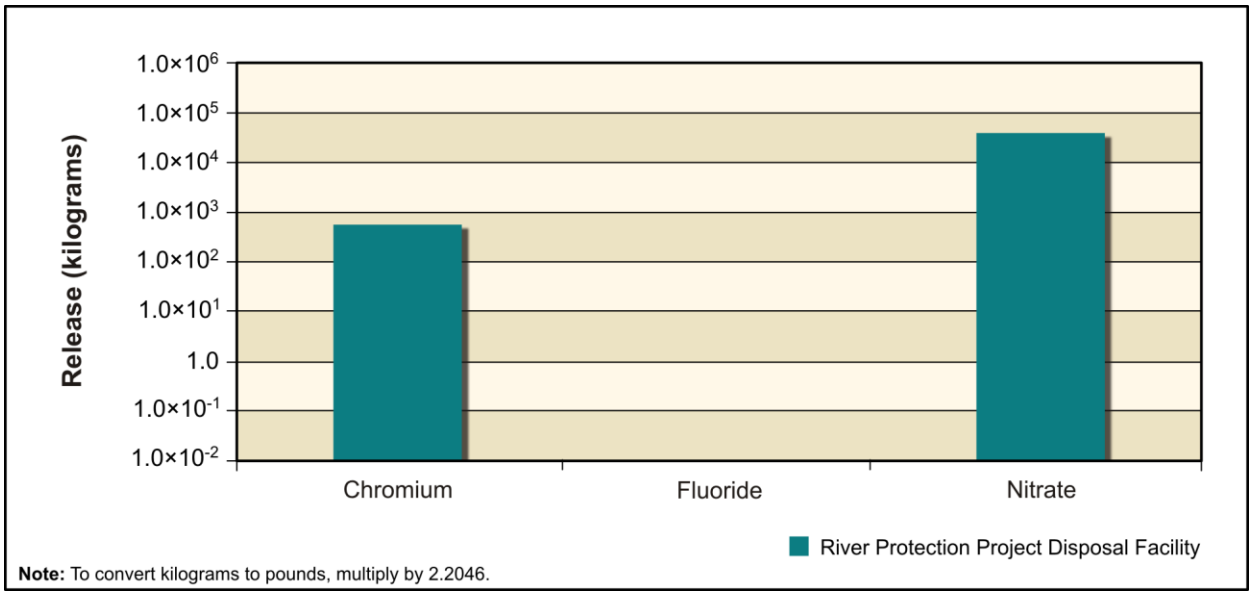


Figure 5–447. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–448 shows the estimated release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–449, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Essentially everything released to groundwater reaches the Columbia River in the analysis for all COPC drivers present.

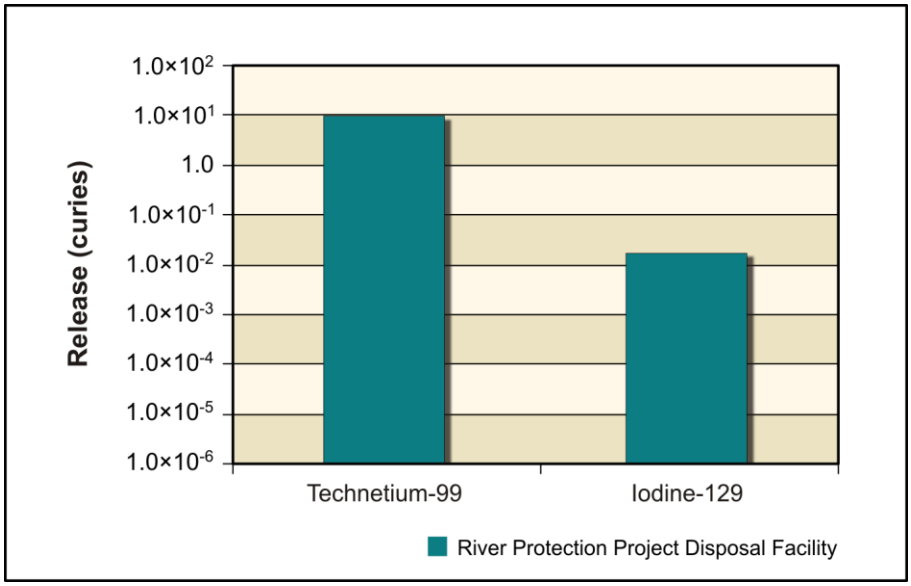


Figure 5–448. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

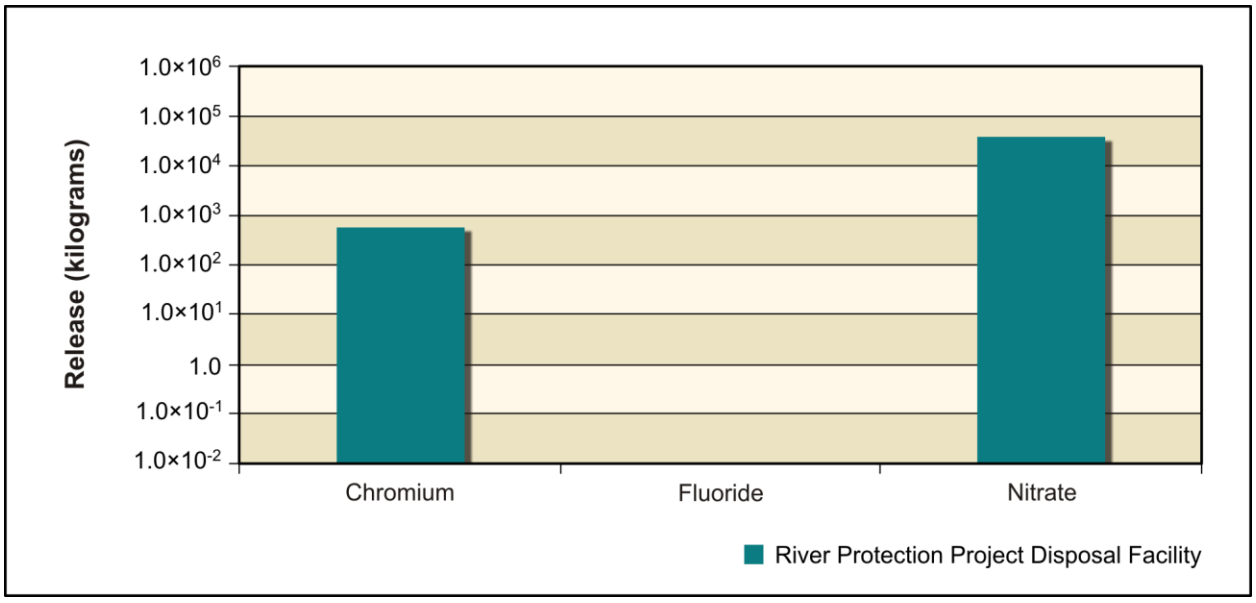


Figure 5–449. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, in terms of groundwater concentration versus time at the RPPDF barrier, IDF-East barrier, Core Zone Boundary, and Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–450 through 5–455). The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over five orders of magnitude.

Table 5–96 lists the maximum concentrations of the COPCs in the peak year at IDF-East and the RPPDF, Core Zone Boundary, and Columbia River nearshore. Under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, peak concentrations of technetium-99 exceed the benchmark at the IDF-East barrier (CY 10,774), Core Zone Boundary (CY 8334), and Columbia River nearshore (CY 10,429). Concentrations of iodine-129 approach or exceed the benchmark at IDF-East (CY 7907), the Core Zone Boundary (CY 7856), and the Columbia River nearshore (CY 7749). Chromium concentrations exceed the benchmark at IDF-East in CY 8608 and at the Core Zone Boundary in CY 8680. No other constituents exceed their benchmark concentrations under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C.

Table 5–96. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Maximum COPC Concentrations in the Peak Year at IDF-East and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)					
Technetium-99	**2,990** (10,774)	42 (3818)	**1,050** (8334)	**904** (10,429)	900
Iodine-129	**2.2** (7907)	0.1 (3747)	0.9 (7856)	0.6 (7749)	1
Chemical (micrograms per liter)					
Acetonitrile	17 (8821)	0 (1940)	6 (8715)	4 (8940)	100
Chromium	**295** (8608)	3 (3740)	**102** (8680)	78 (8594)	100
Nitrate	42,600 (8888)	180 (3670)	16,100 (8973)	12,200 (8783)	45,000

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–450 through 5–453 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers). For technetium-99, a small rise in concentration at the RPPDF barrier, Core Zone Boundary, and Columbia River nearshore is evident in the early years, peaking around CY 3940 but remaining over an order of magnitude below the benchmark concentration. After this first peak, concentrations at the RPPDF barrier and Core Zone Boundary begin to decline. Beginning around CY 5400, concentrations at the IDF-East barrier, RPPDF barrier, Core Zone Boundary, and Columbia River nearshore begin climbing again for the duration of the analysis. Concentrations at IDF-East and the Core Zone Boundary exceed the benchmark by less than an order of magnitude during the simulation period. Concentrations at the RPPDF barrier and Columbia River nearshore approach but never exceed the benchmark. Iodine-129 and chromium follow a pattern similar to that of technetium-99 except the exceedances of the benchmark at IDF-East drop below the benchmark around CY 9500 and CY 10,940, respectively. The signature for nitrate also follows the same pattern, except peak cencentrations never exceed the benchmark. Acetonitrile peaks around CY 8940 at concentrations less than one order of magnitude below the benchmark (see Figure 5–454).

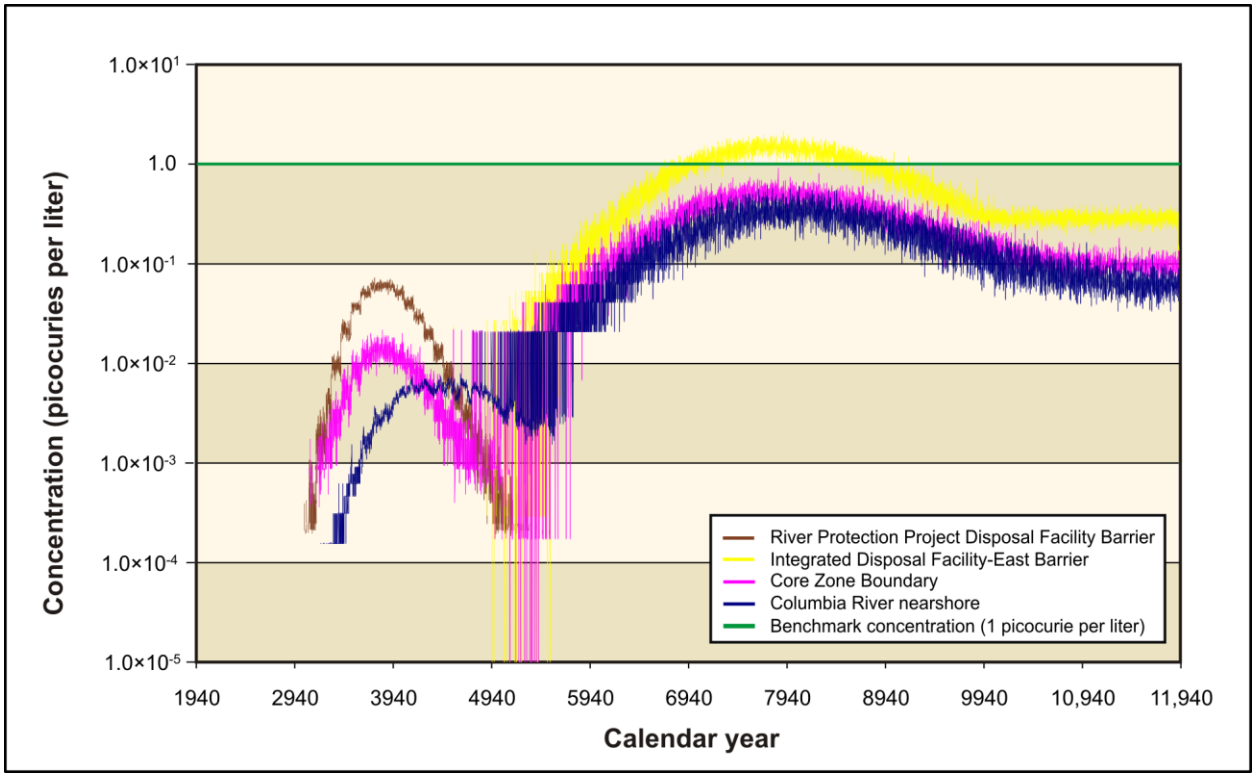


Figure 5–450. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Iodine-129 Concentration Versus Time

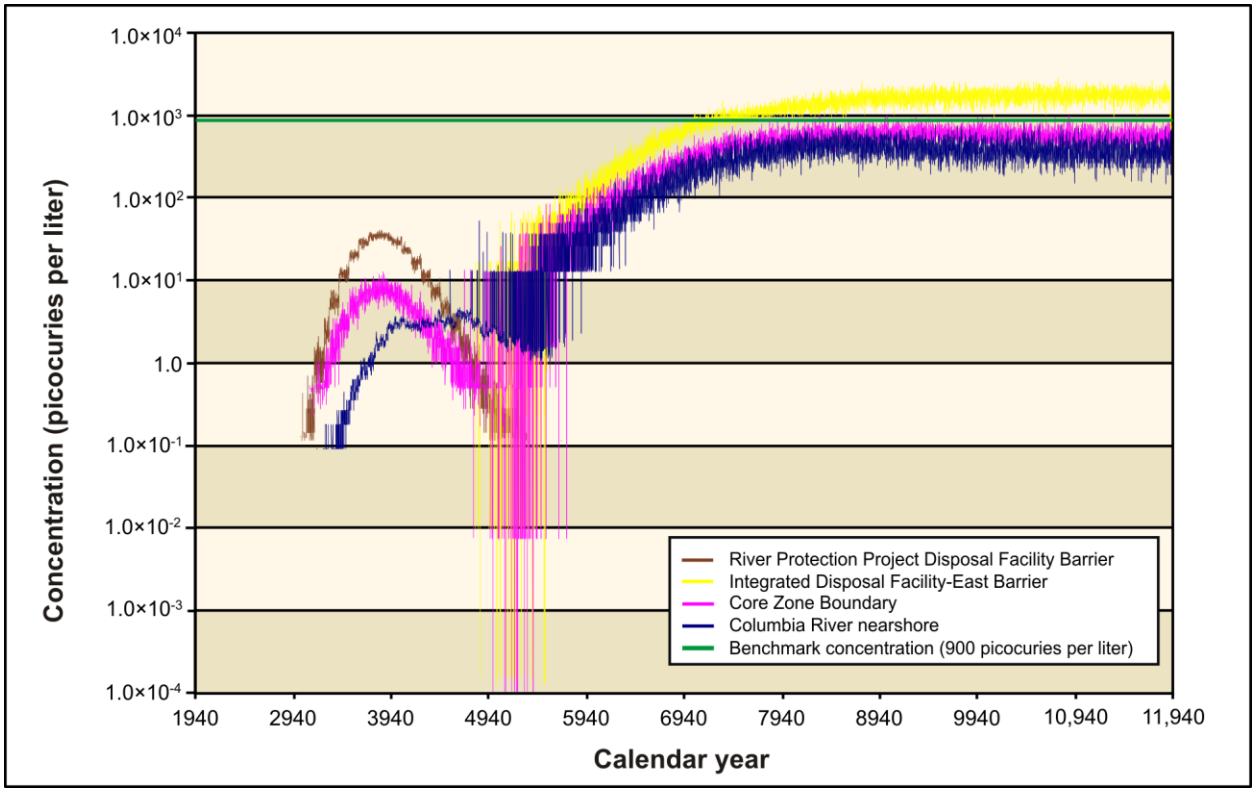


Figure 5–451. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Technetium-99 Concentration Versus Time

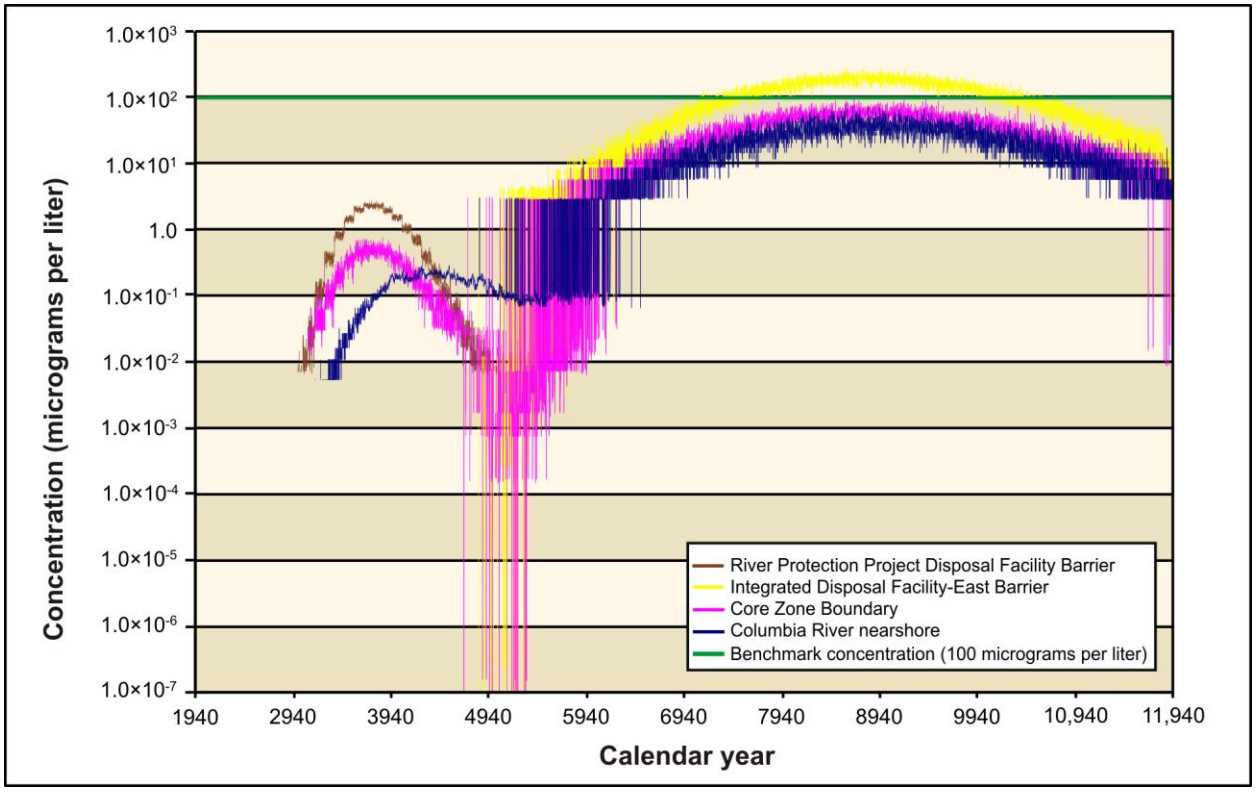


Figure 5–452. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Chromium Concentration Versus Time

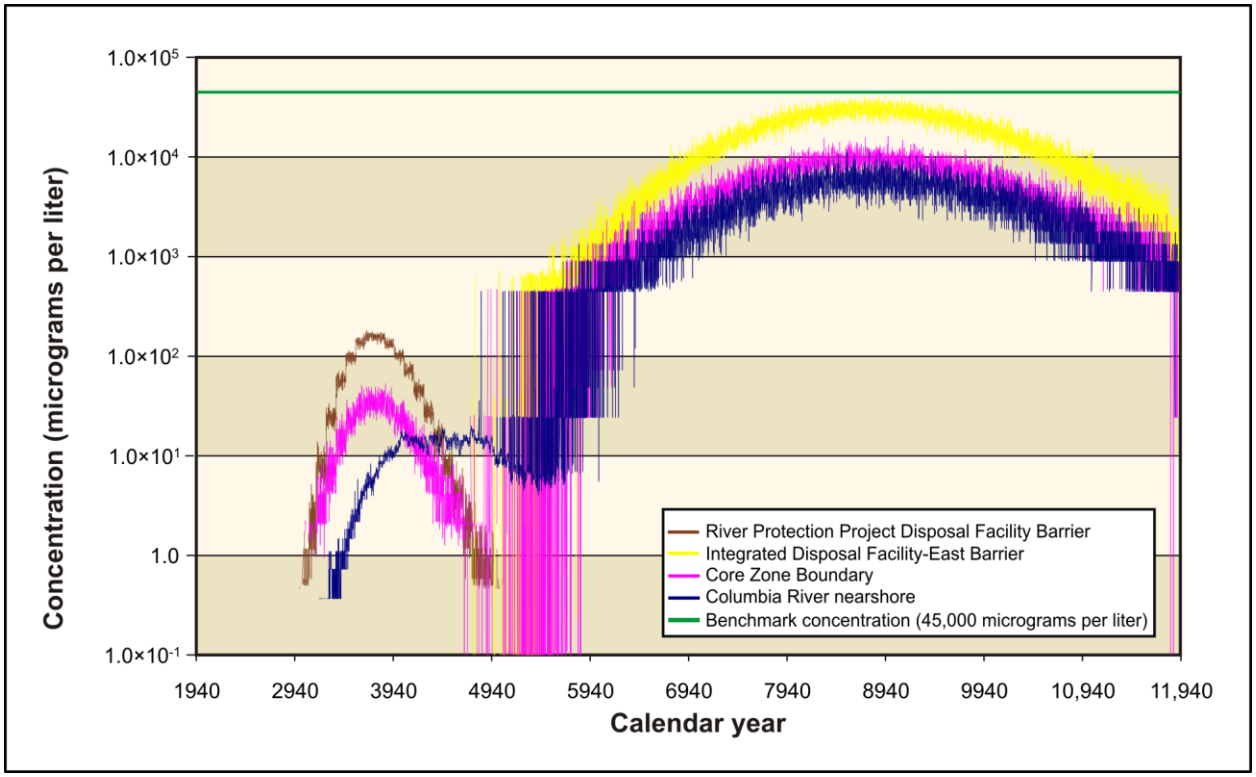


Figure 5–453. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Nitrate Concentration Versus Time

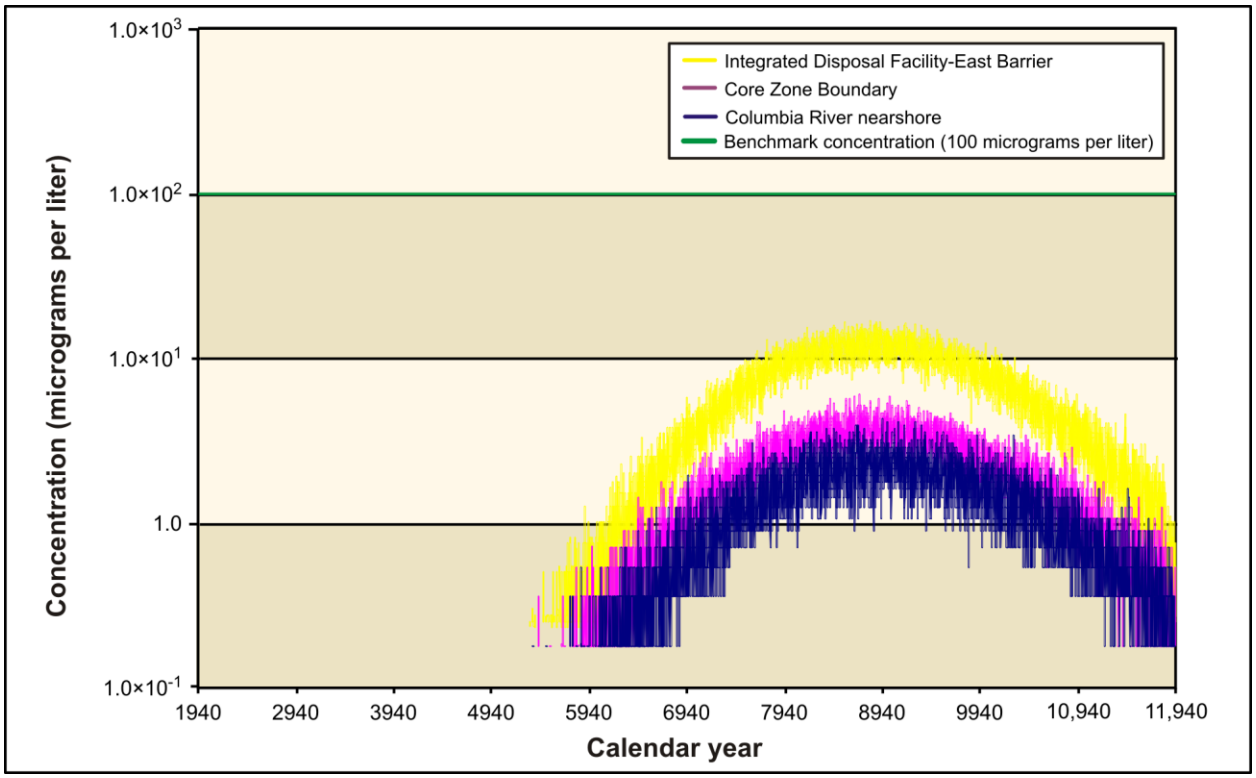


Figure 5–454. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Acetonitrile Concentration Versus Time

Figure 5–455 shows concentration versus time for total uranium. Because of the high retardation of uranium, no contamination appears until just after CY 9940. By the end of the period of analysis, concentrations at the RPPDF barrier and the Core Zone Boundary are approximately 1.0×10^{-7} micrograms per liter.

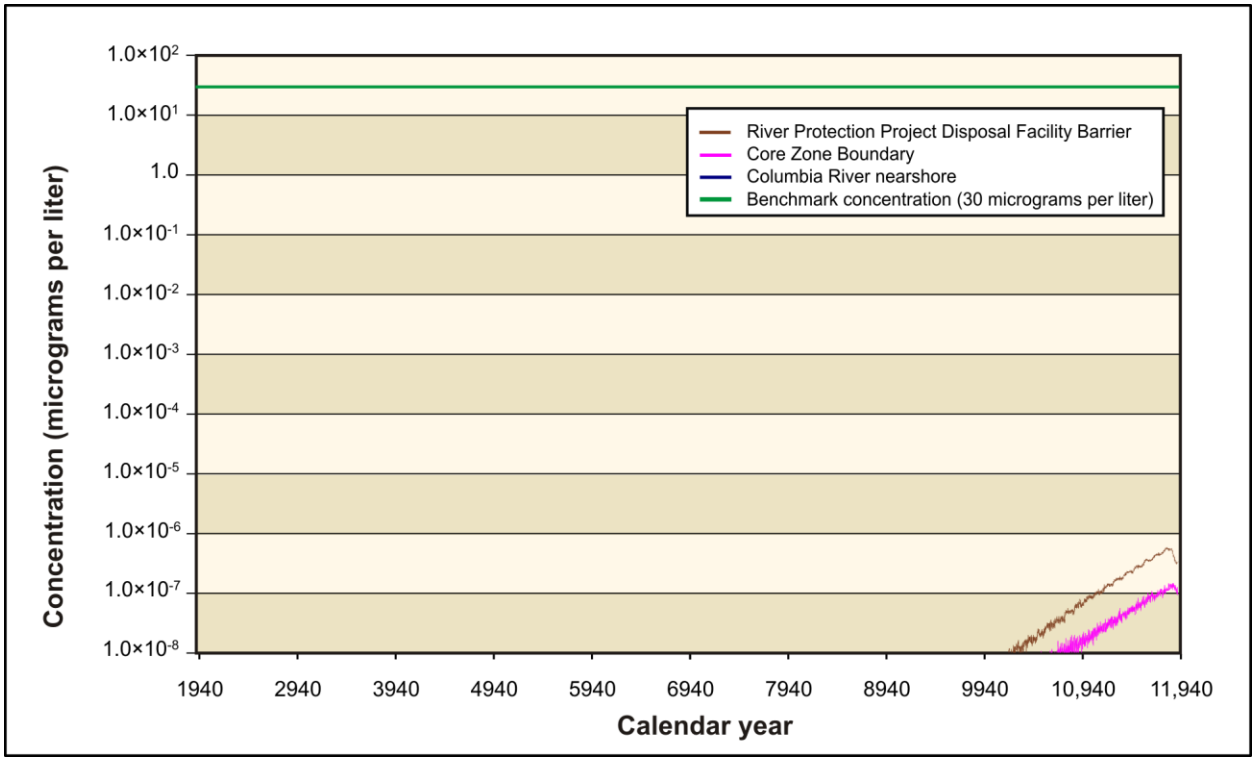
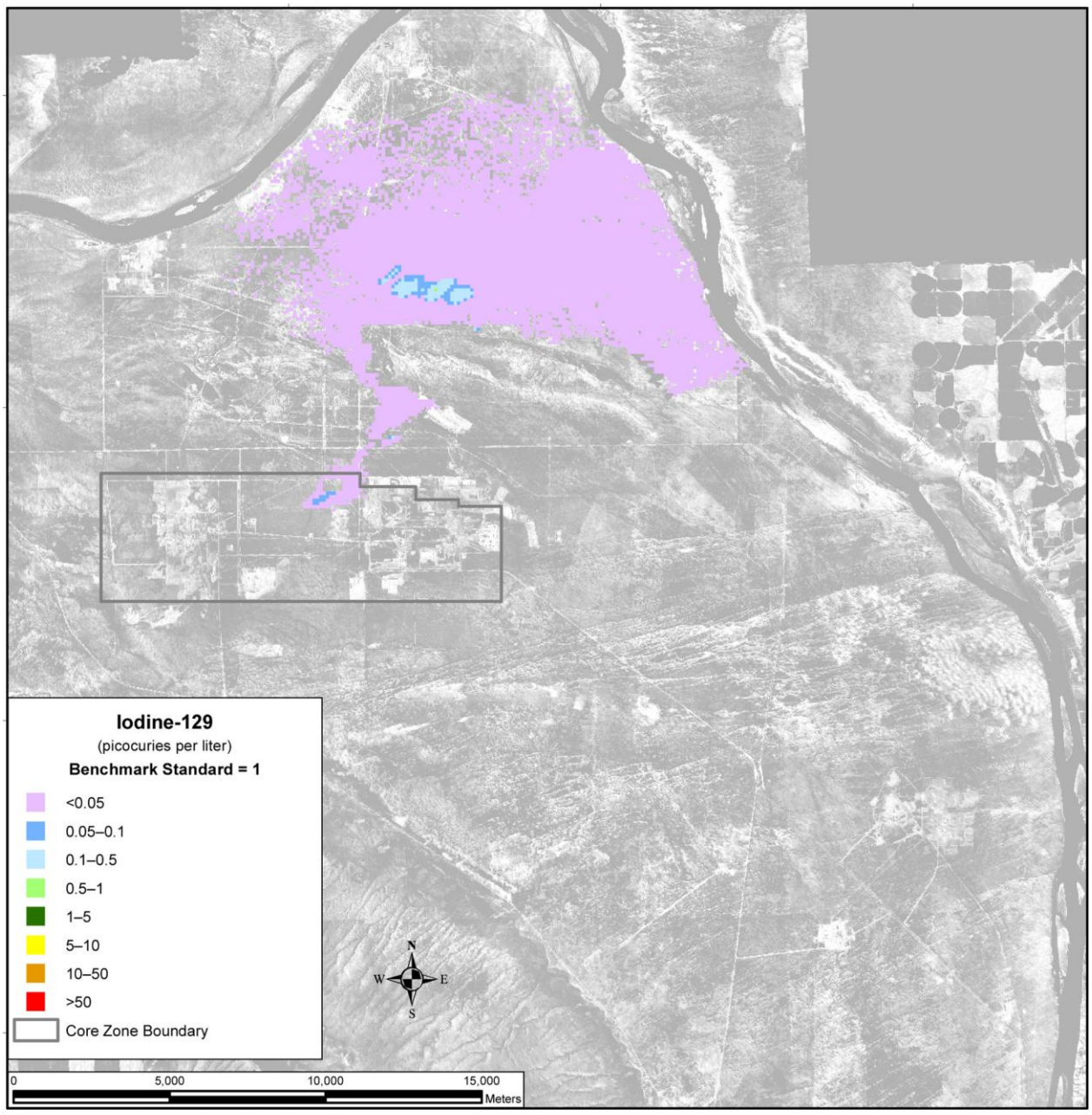


Figure 5–455. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

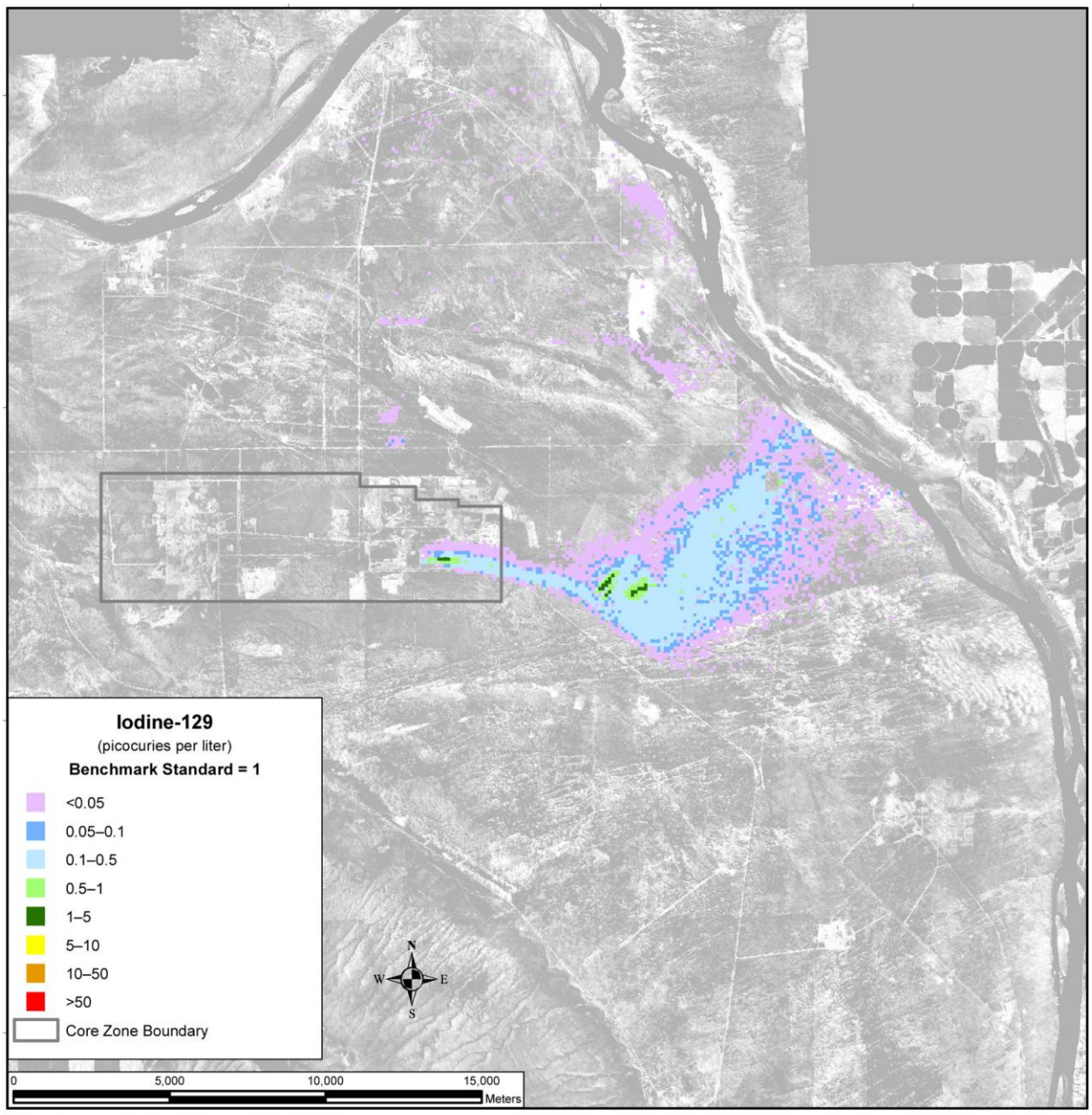
This section presents the impacts of Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–456 through 5–467). Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

In CY 3890, there is a low-concentration plume of iodine-129 (see Figure 5–456) that stretches north from the RPPDF through Gable Gap. By CY 7140 (see Figure 5–457), the plume from the RPPDF has attenuated, but a new plume has formed, traveling east from IDF-East. Maximum concentrations in this plume are about five times the benchmark concentration. Figure 5–458 shows the iodine-129 concentration in CY 11,885. Technetium-99 (see Figures 5–459 through 5–461), chromium (see Figures 5–462 through 5–464), and nitrate (see Figures 5–465 through 5–467) show similar spatial distributions at selected times. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., move at the rate of the pore-water velocity). No appreciable concentrations of total uranium result in contaminant plumes under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, so figures of plume maps for total uranium are not shown.



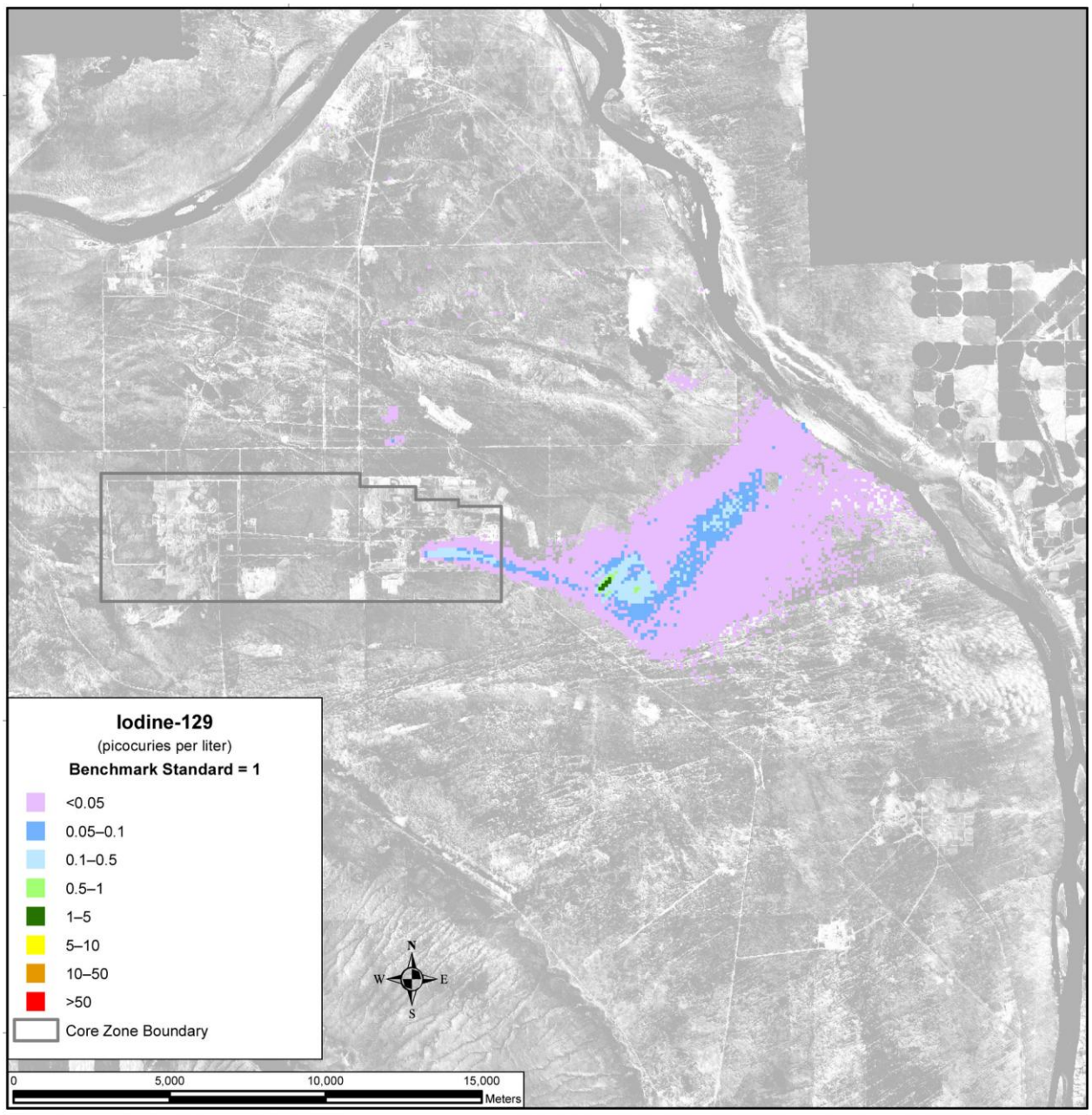
Note: To convert meters to feet, multiply by 3.281.

Figure 5–456. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



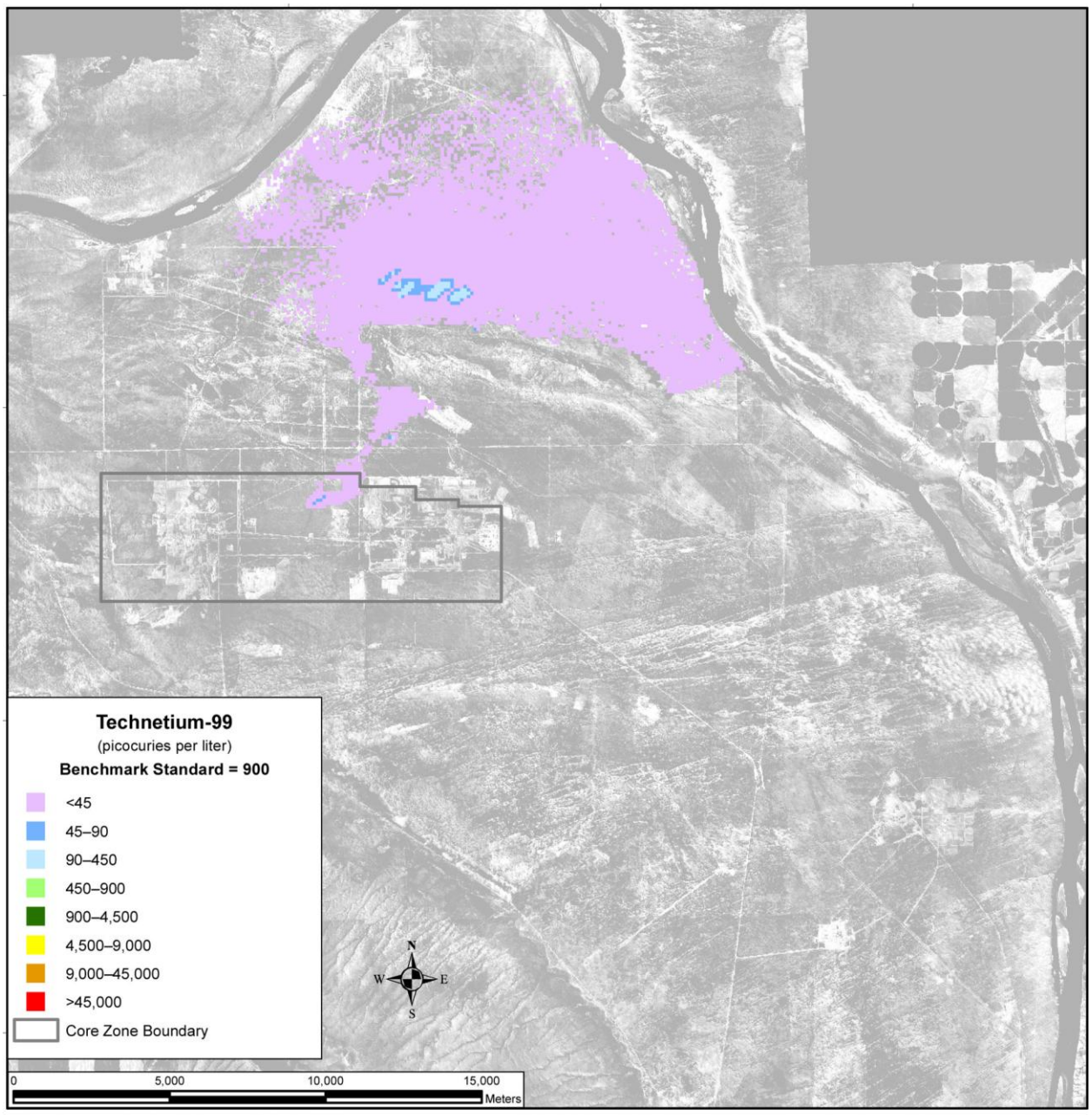
Note: To convert meters to feet, multiply by 3.281.

Figure 5–457. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



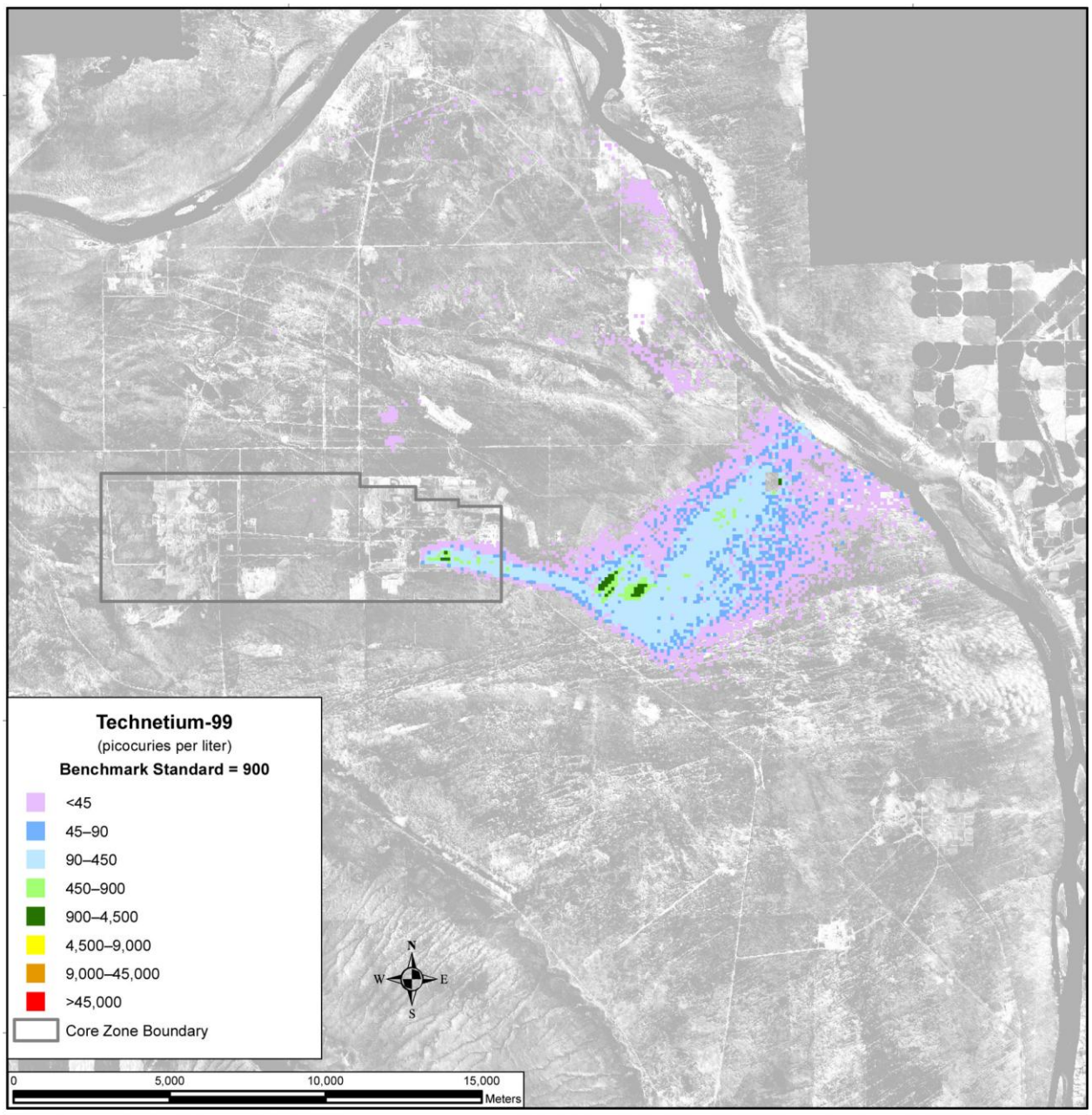
Note: To convert meters to feet, multiply by 3.281.

Figure 5–458. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



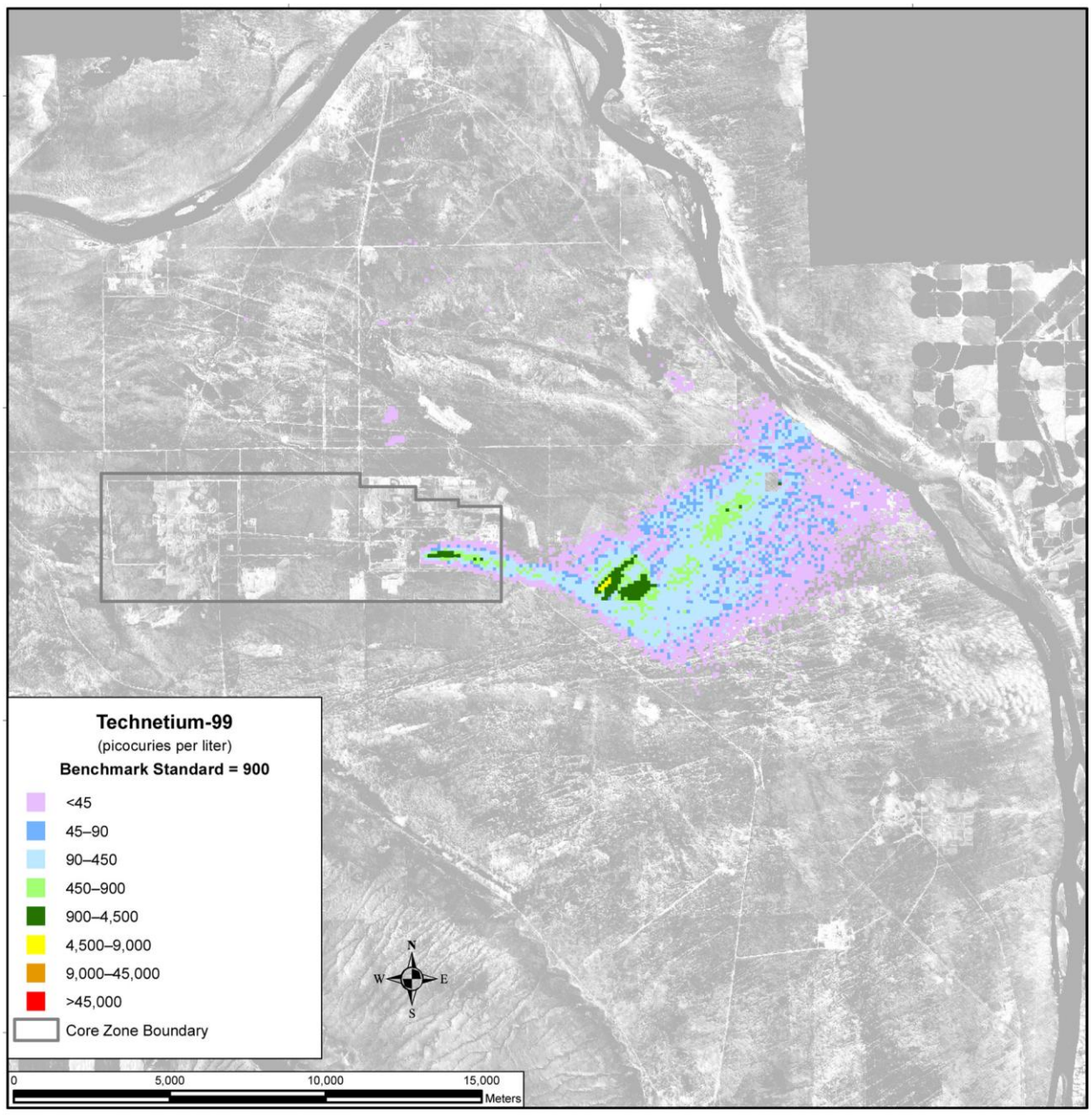
Note: To convert meters to feet, multiply by 3.281.

Figure 5–459. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



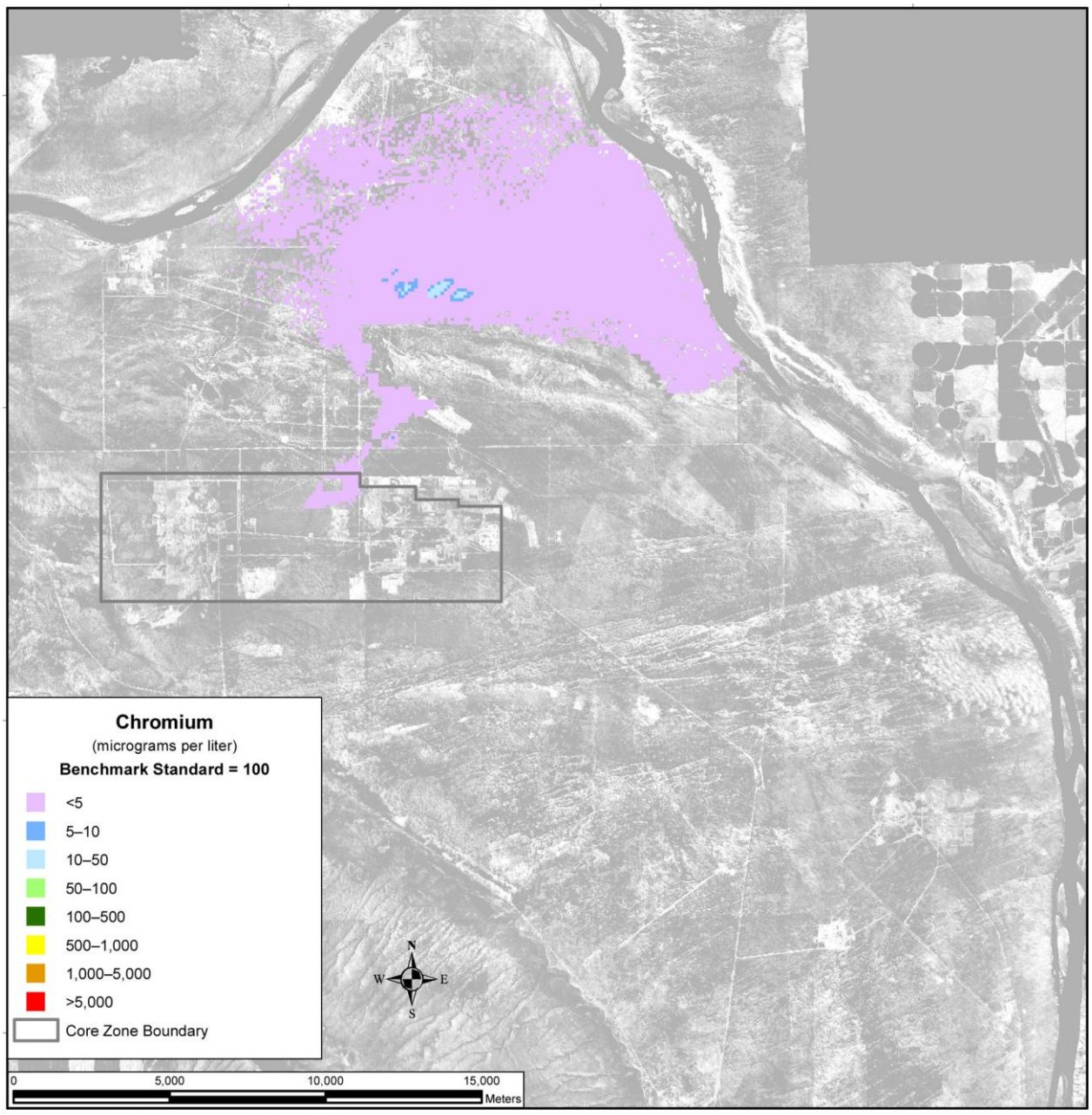
Note: To convert meters to feet, multiply by 3.281.

Figure 5–460. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



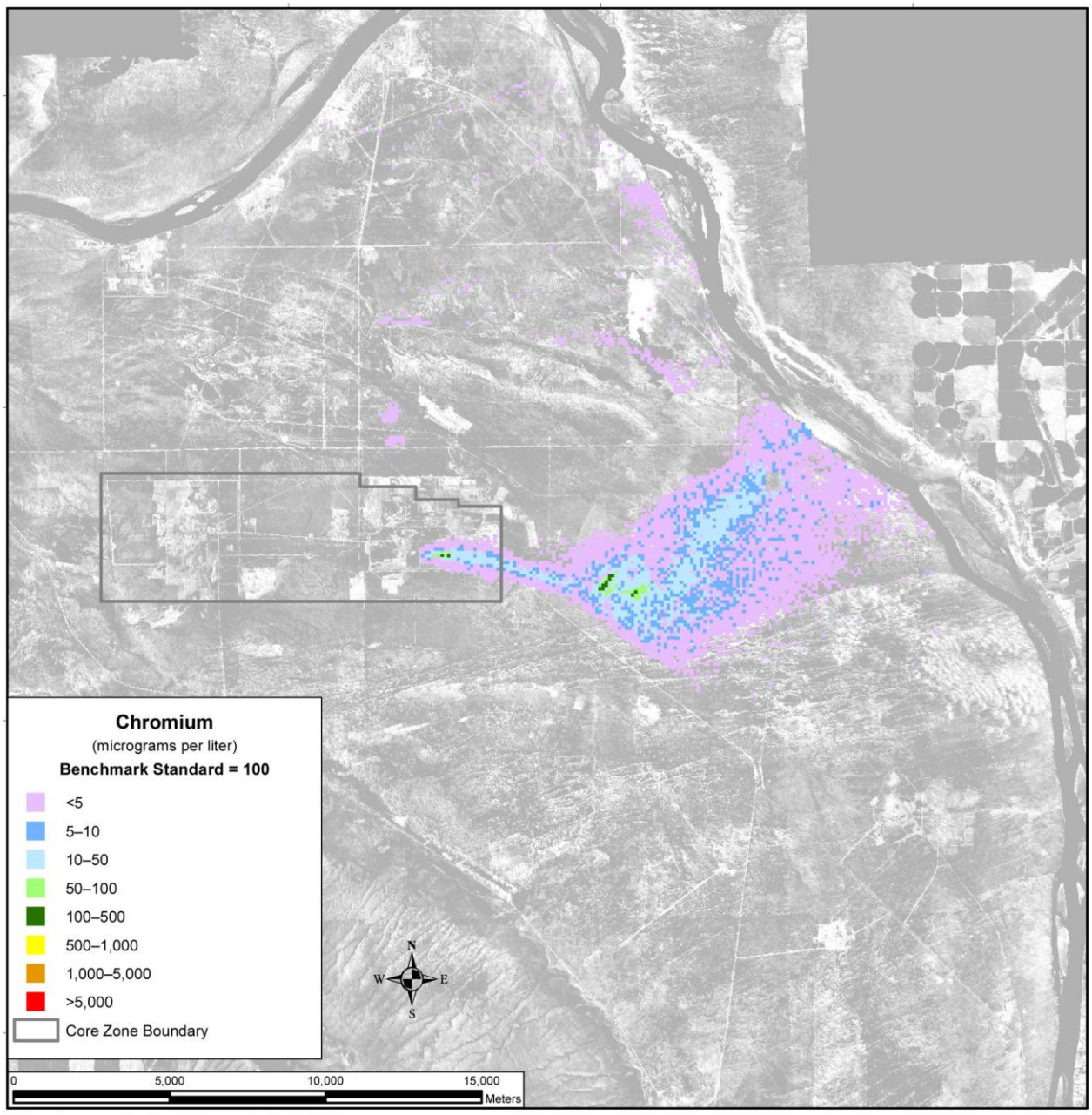
Note: To convert meters to feet, multiply by 3.281.

Figure 5–461. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



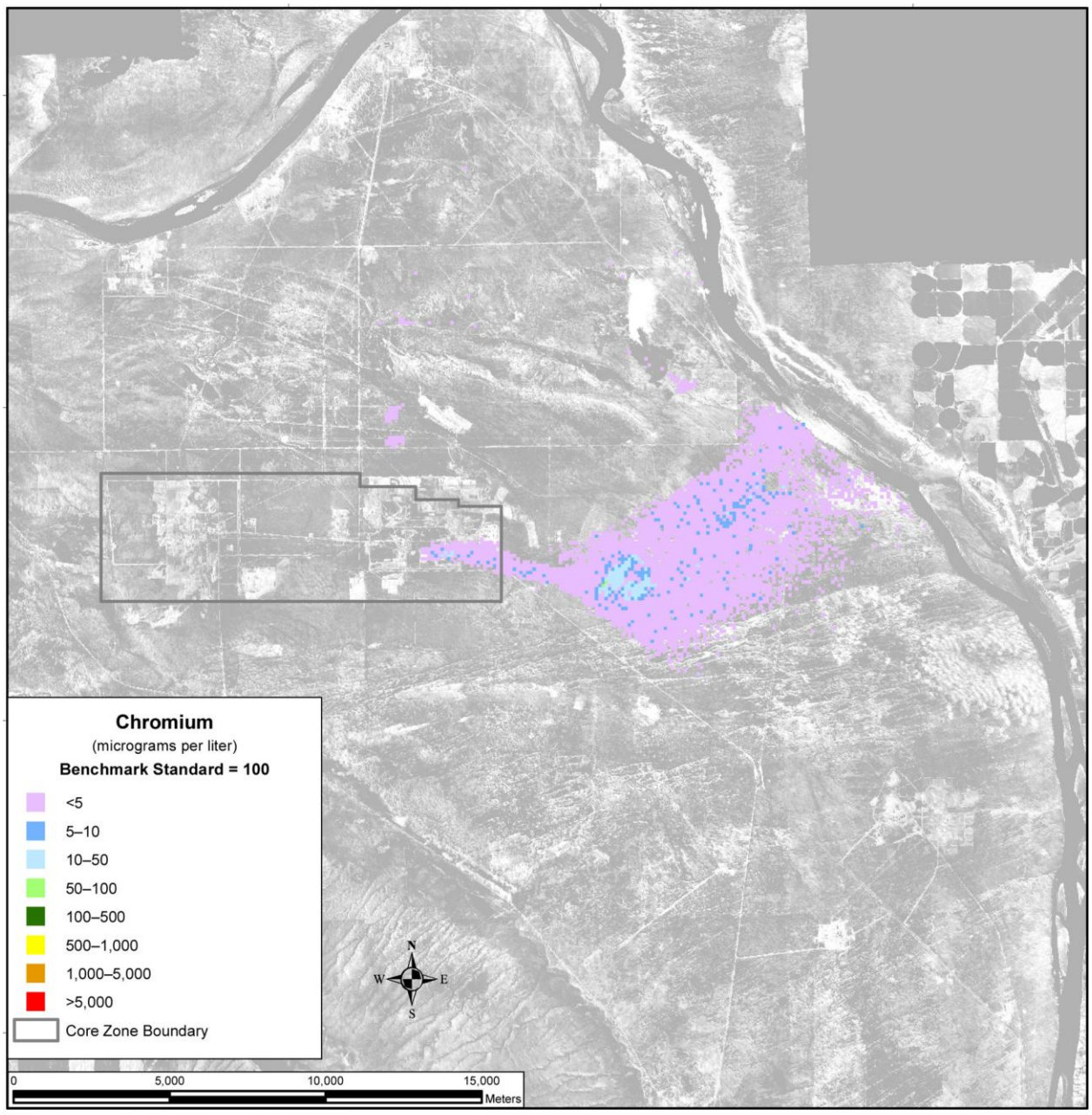
Note: To convert meters to feet, multiply by 3.281.

Figure 5–462. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



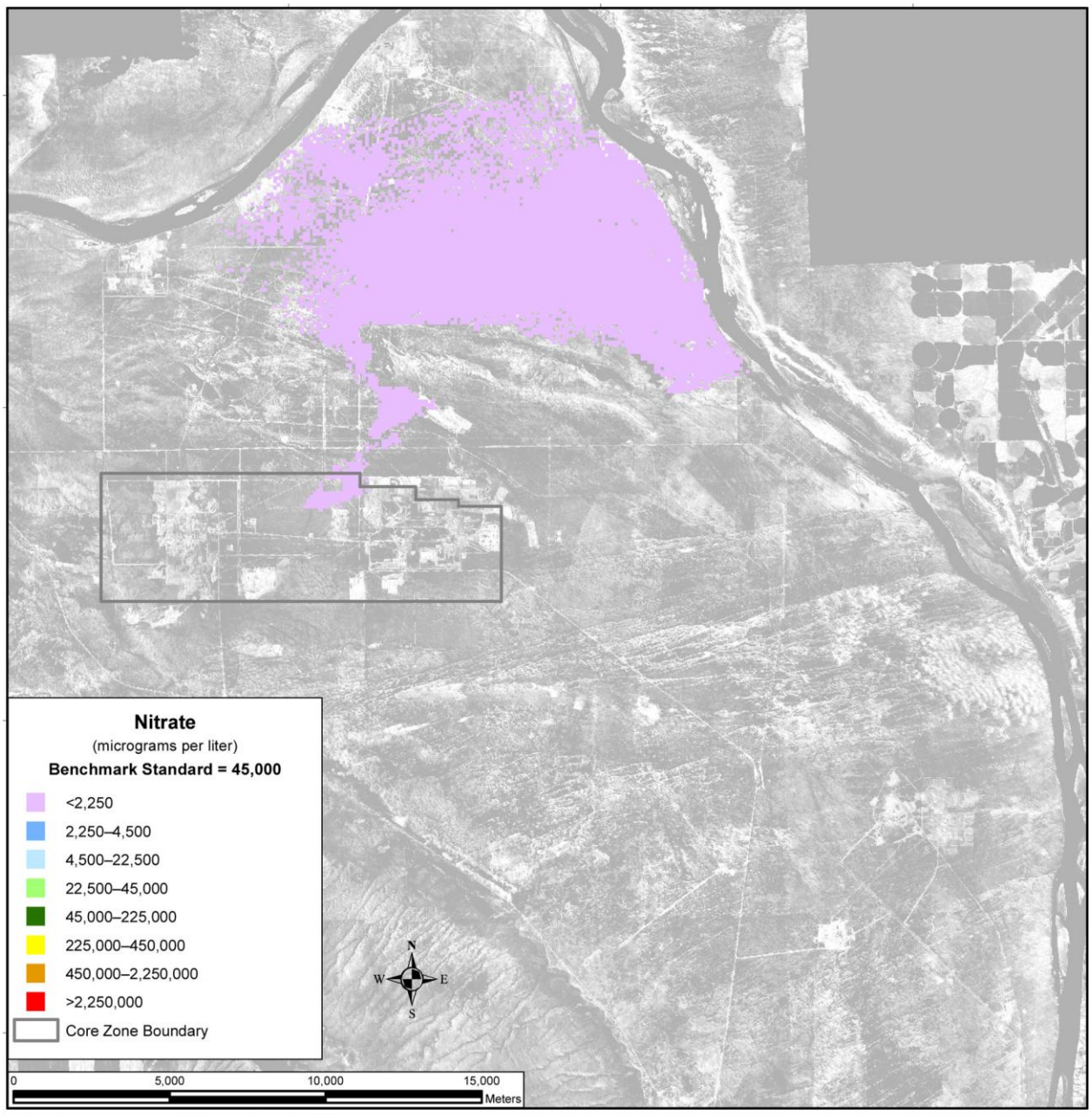
Note: To convert meters to feet, multiply by 3.281.

Figure 5–463. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



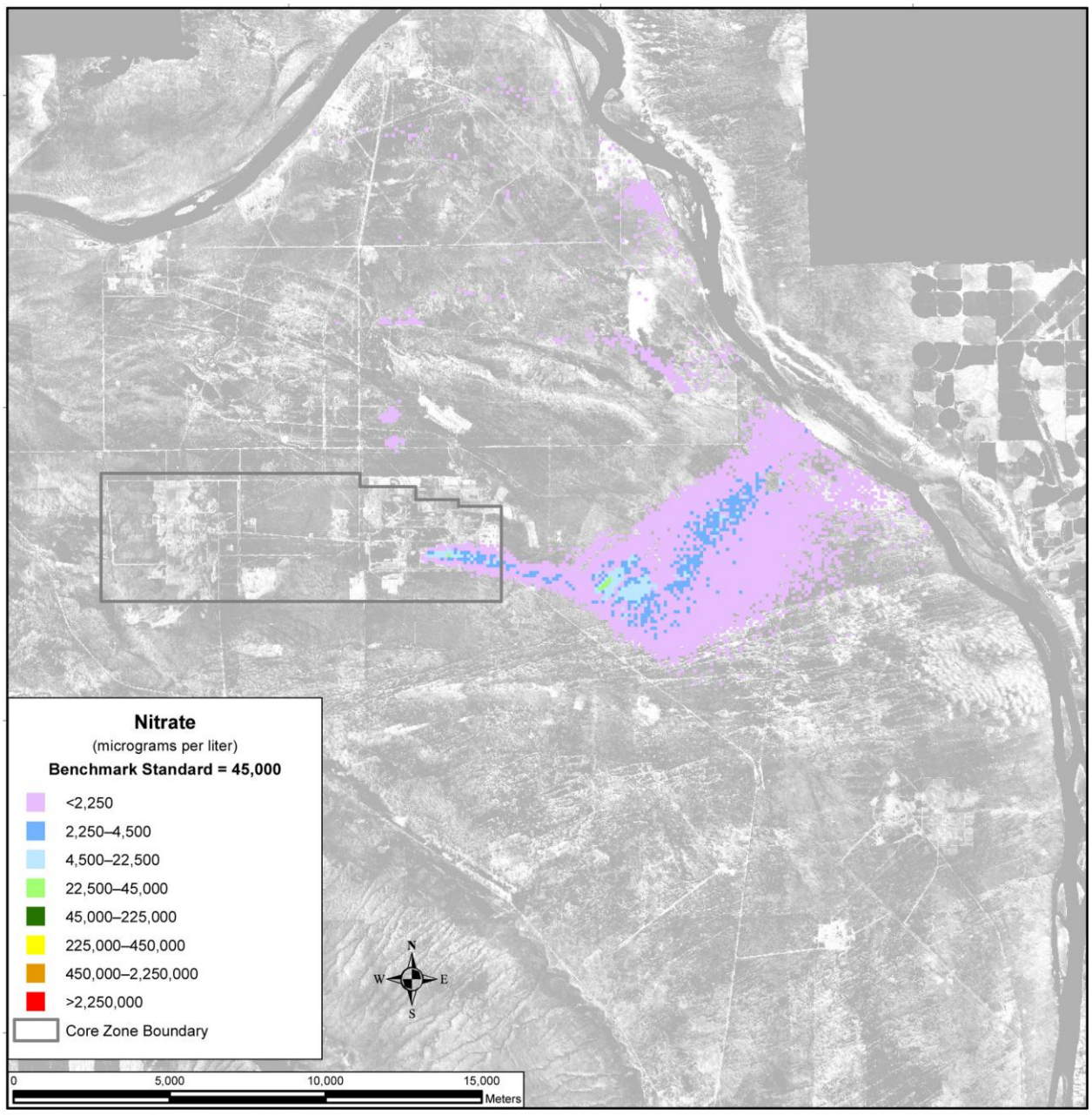
Note: To convert meters to feet, multiply by 3.281.

Figure 5–464. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



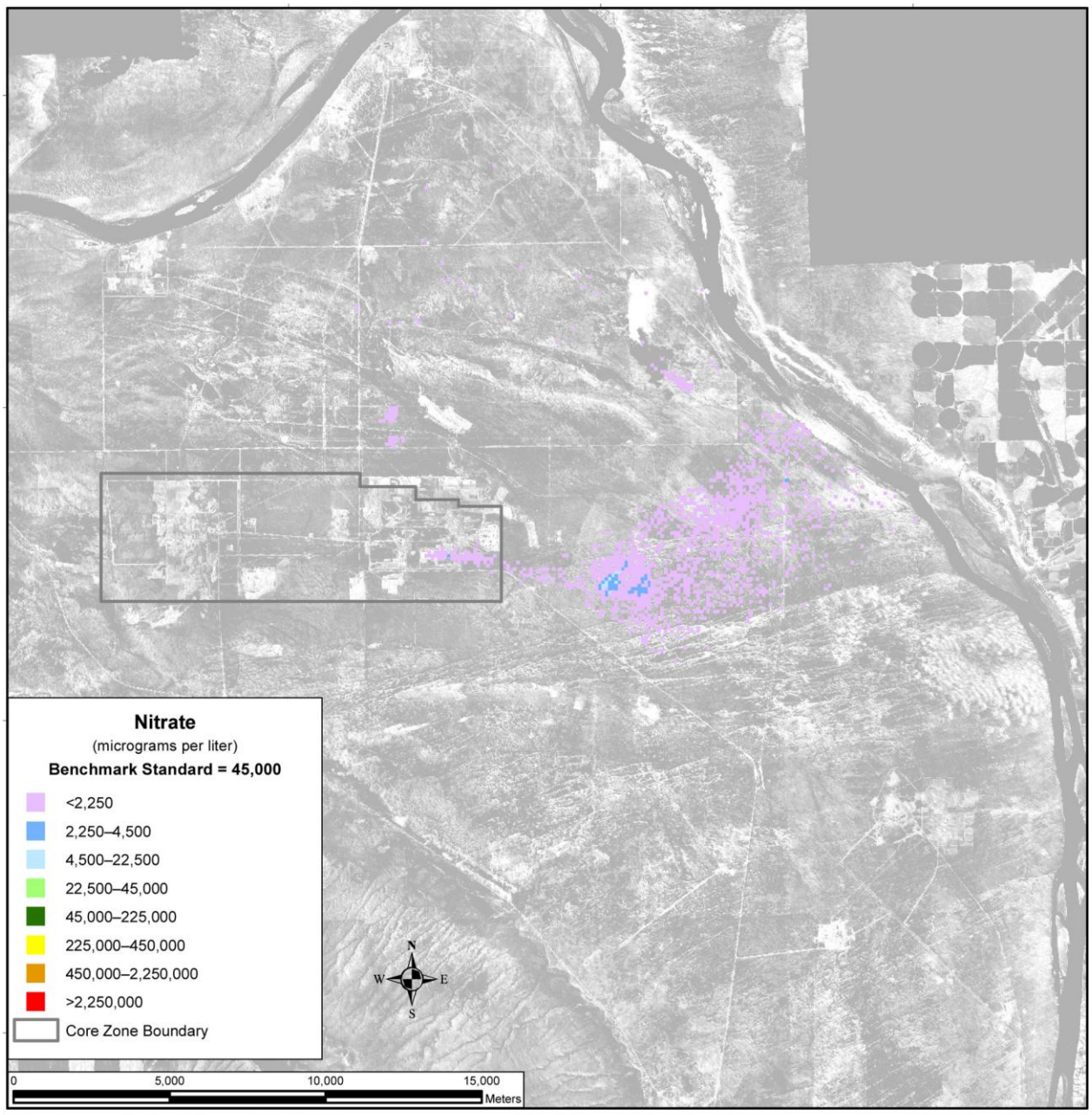
Note: To convert meters to feet, multiply by 3.281.

Figure 5–465. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–466. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–467. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, in general, discharges from IDF-East are the predominant contributors. The RPPDF is a secondary contributor.

For the conservative tracers, concentrations at IDF-East are the most intense and exceed the benchmark concentrations for iodine-129, technetium-99, and chromium by less than an order of magnitude. Concentrations of iodine-129, technetium-99, and chromium also reach their respective benchmark concentrations at the Core Zone Boundary. Iodine-129 and technetium-99 are the only COPC drivers exceeding their respective benchmarks at the Columbia River nearshore. Concentrations of nitrate never

exceed the benchmark concentration during the period of analysis. Acetonitrile peaks around CY 8940, less than one order of magnitude below the benchmark.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentration of total uranium remains well below the benchmark at the Core Zone Boundary and the Columbia River nearshore throughout the simulation.

5.3.1.2.1.4 Disposal Group 1, Subgroup 1-D

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Disposal Group 1, Subgroup 1-D, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 3C and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Waste would be converted to IHLW, ILAW glass, and steam reforming waste. IHLW would be stored on site, while ILAW glass and steam reforming waste would be disposed of in IDF-East.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and the RPPDF in CY 2009 and continue through CY 2050, when these facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in the facilities would become available for release to the environment, and modified RCRA Subtitle C barriers would be emplaced over IDF-East and the RPPDF to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 2. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 2 is focused on the following COPC drivers:

- Radiological risk drivers: technetium-99 and iodine-129
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, nitrate, fluoride, and total uranium

The COPC drivers for Waste Management Alternative 2 were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 2.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. Total uranium was added to the list because it begins to appear toward the end of the period of analysis. Total uranium is long-lived, or stable, but is not as mobile as the other COPC drivers; it moves about seven times more slowly than groundwater. The other COPCs that were analyzed do not significantly contribute to

drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Disposal Group 1, Subgroup 1-D, in terms of the total amount of COPCs released to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms (see Figures 5–468 through 5–479). Eight subtotals are plotted for IDF-East, representing releases from ILAW glass, ETF-generated secondary waste, tank closure secondary waste, FFTF Decommissioning Alternative 3 waste, onsite and offsite waste, steam reforming waste, retired melters, and waste management secondary waste. Release plots from the RPPDF are also included. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over eight orders of magnitude within the same series of figures.

Figure 5–468 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–469, the chemical hazard drivers. Technetium-99 is released to the vadose zone from each of the subtotaled sources, with steam reforming waste and offsite waste contributing the most. Iodine-129 is released from seven of the sources, with ETF-generated secondary waste, steam reforming waste, and offsite waste contributing the most. Chromium is also released from eight sources, with steam reforming waste and tank closure secondary waste providing the most releases. Nitrate is released only from ETF-generated secondary waste, waste management secondary waste, and onsite waste. Fluoride is released only from waste management secondary waste and onsite waste.

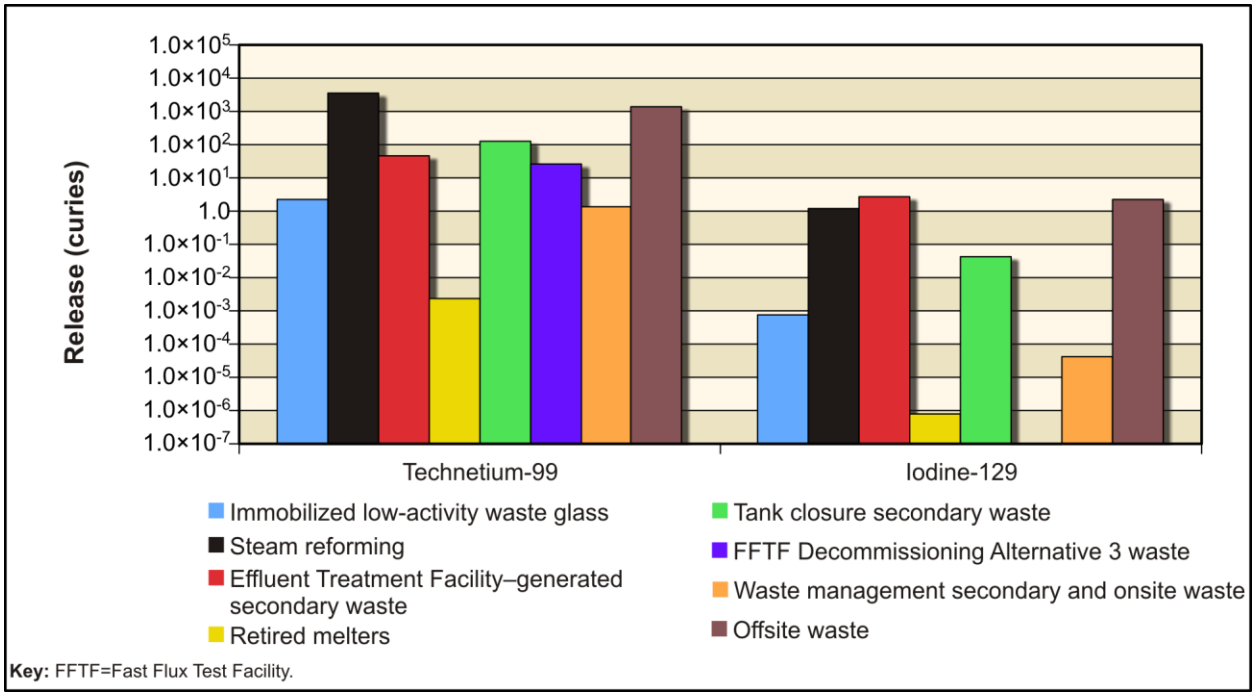


Figure 5–468. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

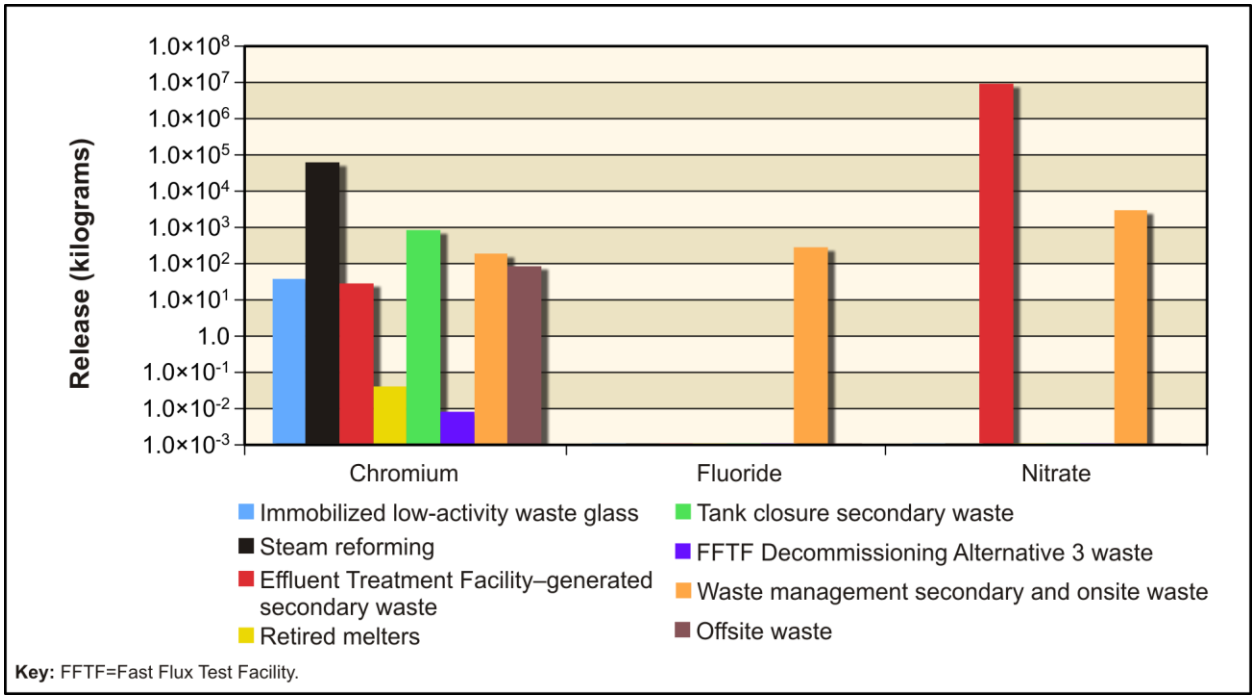


Figure 5–469. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–470 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–471, the chemical hazard drivers. Release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For the conservative tracers (technetium-99, iodine-129, chromium, nitrate, and fluoride), the amount released to groundwater is typically equal to the amount released to the vadose zone. For technetium-99, the amount released to groundwater is essentially equal to that released to the vadose zone for ETF-generated secondary waste and offsite waste. For ILAW glass, retired melters, waste management secondary waste, steam reforming waste, and tank closure secondary waste, about 45 to 55 percent of the technetium-99 released to the vadose zone is transferred to groundwater. For FFTF Decommissioning Alternative 3 waste, about 65 percent of the technetium-99 released to the vadose zone is transferred to groundwater. For iodine-129, the amount released to groundwater is essentially equal to that released to the vadose zone for offsite waste. For ILAW glass, ETF-generated secondary waste, tank closure secondary waste, waste management secondary waste, steam reforming waste, and onsite waste, about 40 to 50 percent of the iodine-129 released to the vadose zone is transferred to groundwater. For chromium, the amount released to groundwater is essentially equal to that released to the vadose zone for ETF-generated secondary waste, tank closure secondary waste, waste management secondary waste, FFTF Decommissioning Alternative 3 waste, and onsite and offsite waste. For ILAW glass, steam reforming waste, and retired melters, about 40 percent of the chromium released to the vadose zone is transferred to groundwater. For nitrate, the amount released to groundwater is essentially equal to that released to the vadose zone for ETF-generated secondary waste, waste management secondary waste, and onsite waste. For fluoride, the amount released to groundwater is essentially equal to that released to the vadose zone for waste management secondary waste and onsite waste.

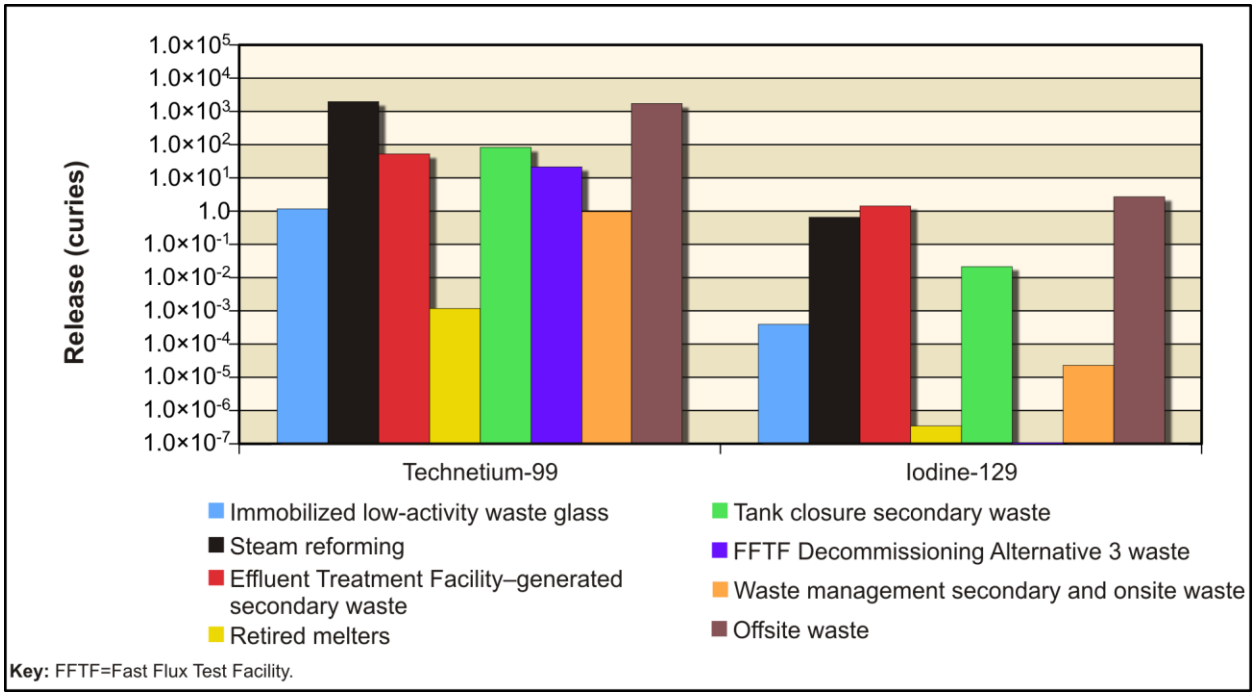


Figure 5–470. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

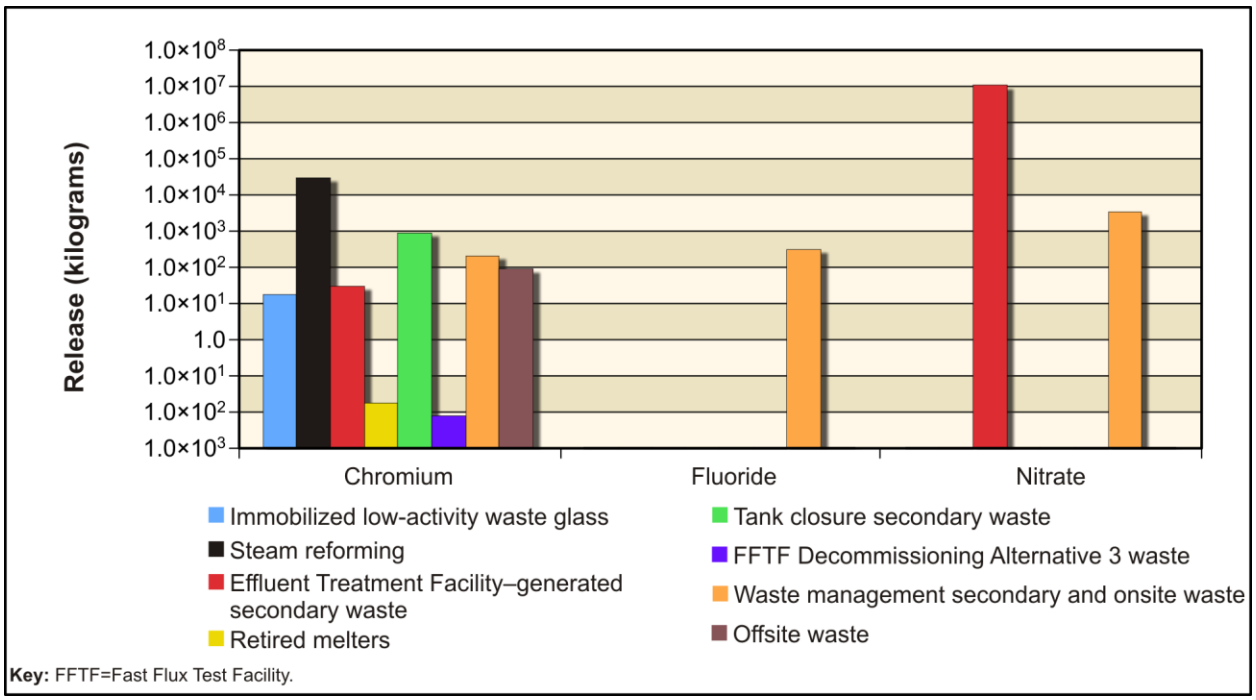


Figure 5–471. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–472 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–473, the chemical hazard drivers. For the conservative tracers (technetium-99, iodine-129, chromium, nitrate, and fluoride), the amount released to the Columbia River is typically essentially equal to the amount released to the vadose zone. For technetium-99, the amount released to the Columbia River from groundwater is about 96 to 100 percent for ILAW glass, steam reforming waste, ETF-generated secondary waste, retired melters, tank closure secondary waste, FFTF Decommissioning Alternative 3 waste, waste management secondary waste, and onsite and offsite waste. For iodine-129, the amount released to the Columbia River from groundwater is about 96 to 100 percent for ILAW glass, steam reforming waste, ETF-generated secondary waste, tank closure secondary waste, and offsite waste. Essentially none of the iodine-129 released from retired melters, waste management secondary waste, and onsite waste to groundwater is transferred to the Columbia River. For chromium, the amount released to the Columbia River from groundwater is about 90 to 100 percent for ILAW glass, steam reforming waste, ETF-generated secondary waste, tank closure secondary waste, retired melters, waste management secondary waste, and onsite and offsite waste. For nitrate, the amount released to the Columbia River is essentially equal to that released to groundwater for ETF-generated secondary waste, waste management secondary waste, and onsite and offsite waste. For fluoride, the amount released to the Columbia River is essentially equal to that released to groundwater for waste management secondary waste and onsite waste.

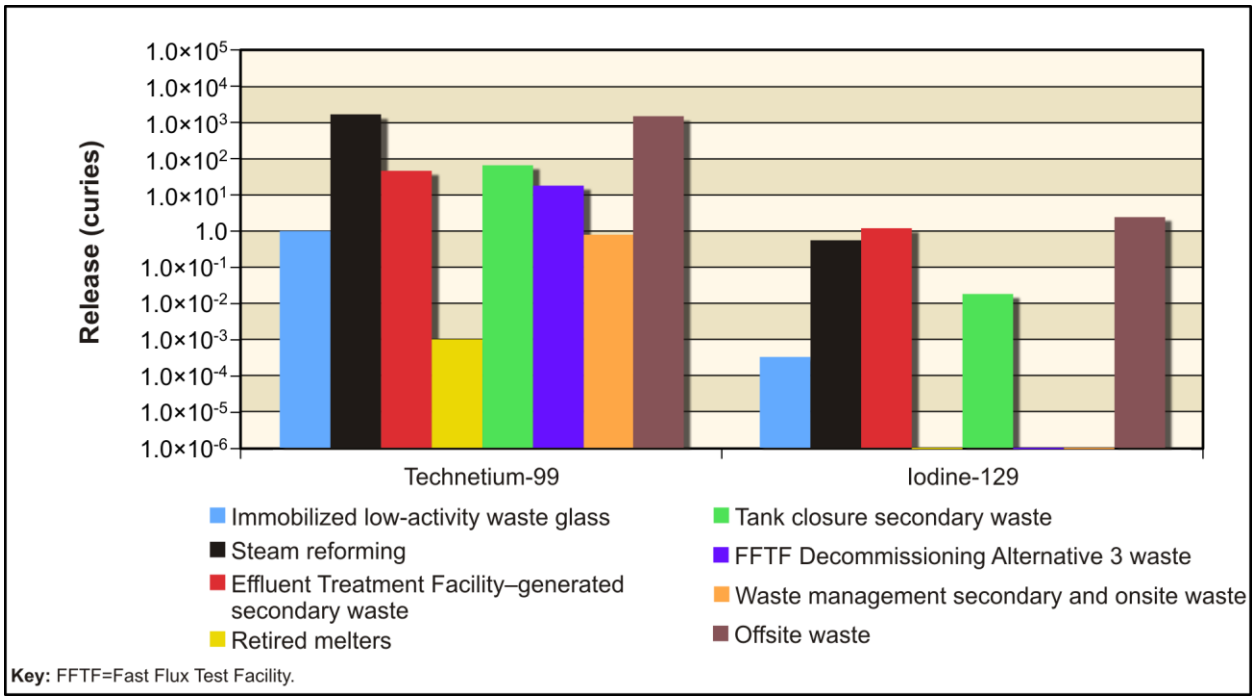


Figure 5–472. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

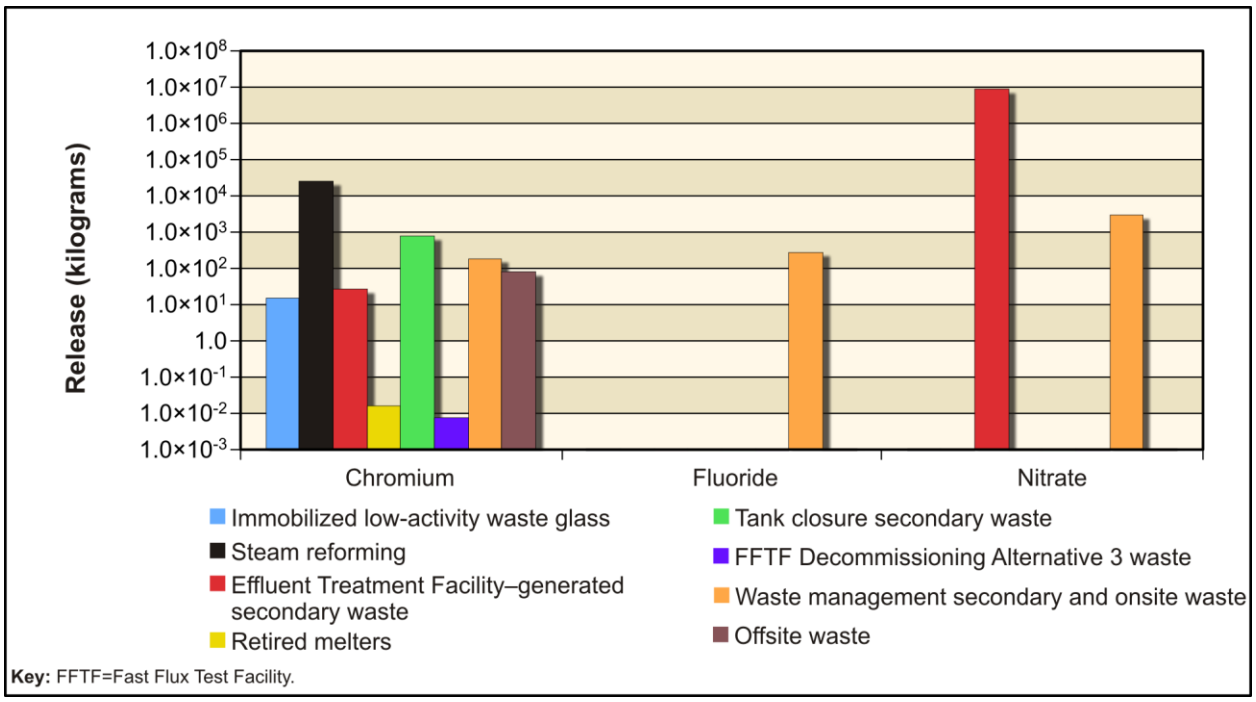


Figure 5–473. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

Figure 5–474 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–475, the chemical hazard drivers. The only constituents released to the vadose zone from the RPPDF are technetium-99, iodine-129, chromium, and nitrate.

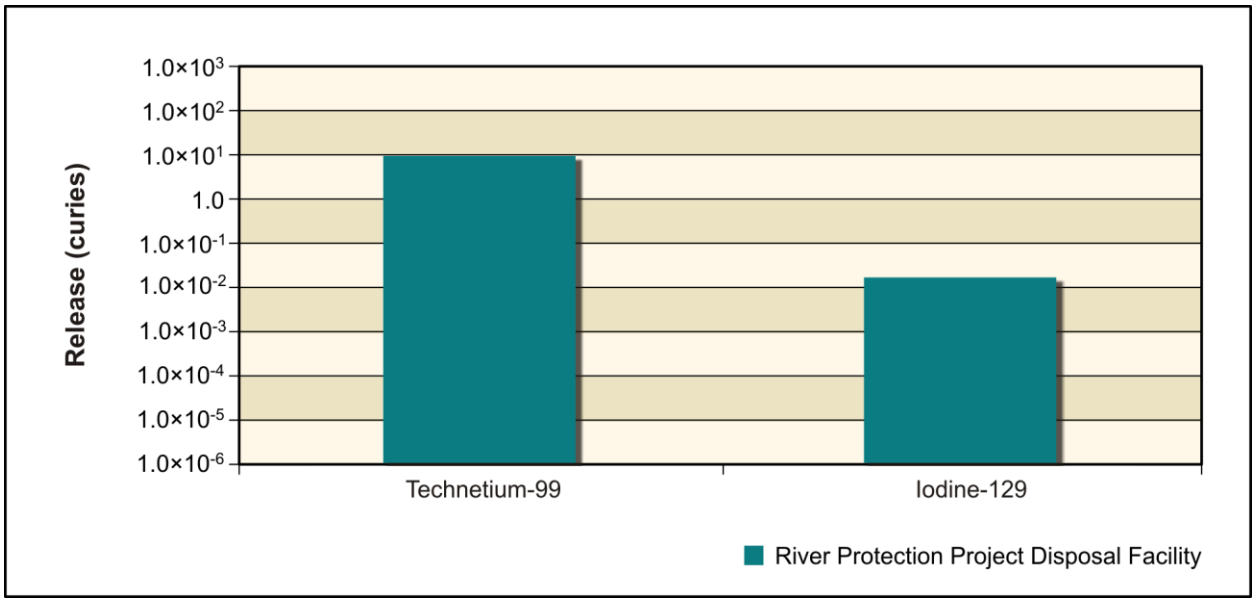


Figure 5–474. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

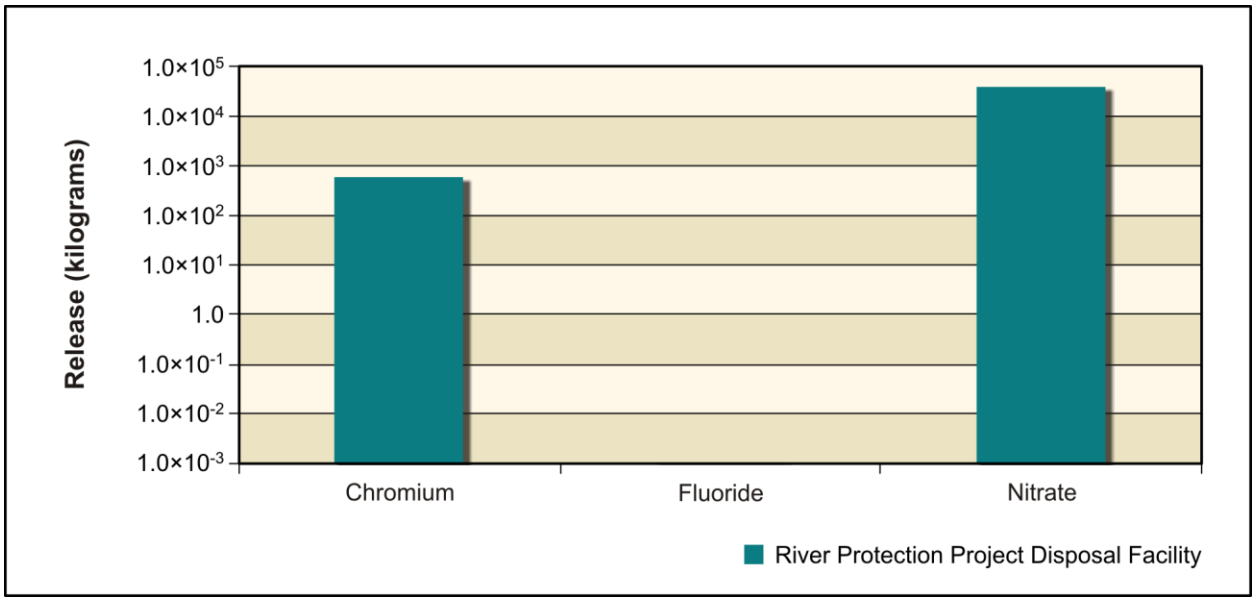


Figure 5–475. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–476 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–477, the chemical hazard drivers. For the RPPDF, the amount released to groundwater is essentially equal to that released to the vadose zone for technetium-99, iodine-129, chromium, and nitrate.

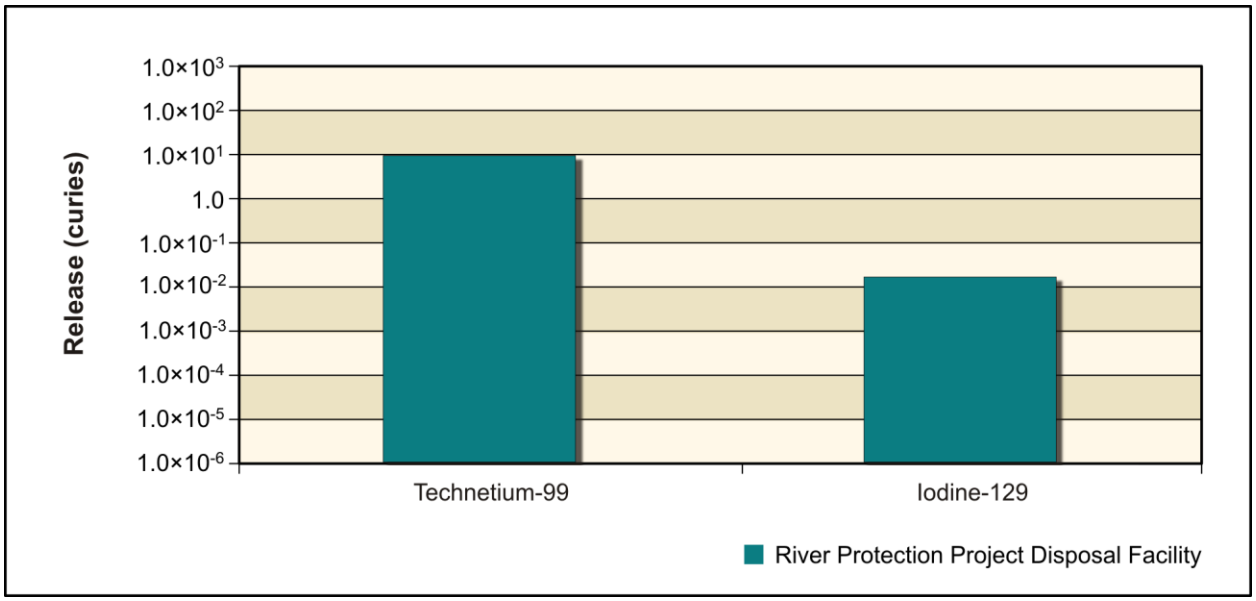


Figure 5–476. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

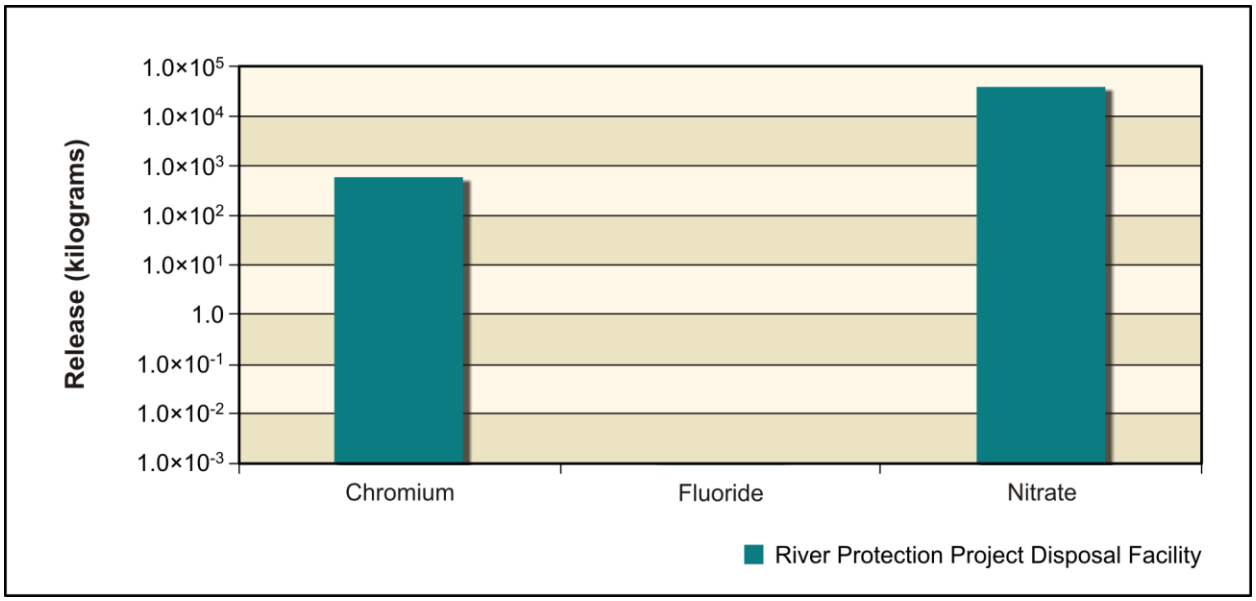


Figure 5–477. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–478 shows the estimated release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–479, the chemical hazard drivers. For the RPPDF, about 95 percent of technetium-99, iodine-129, chromium, and nitrate released to groundwater reaches the Columbia River.

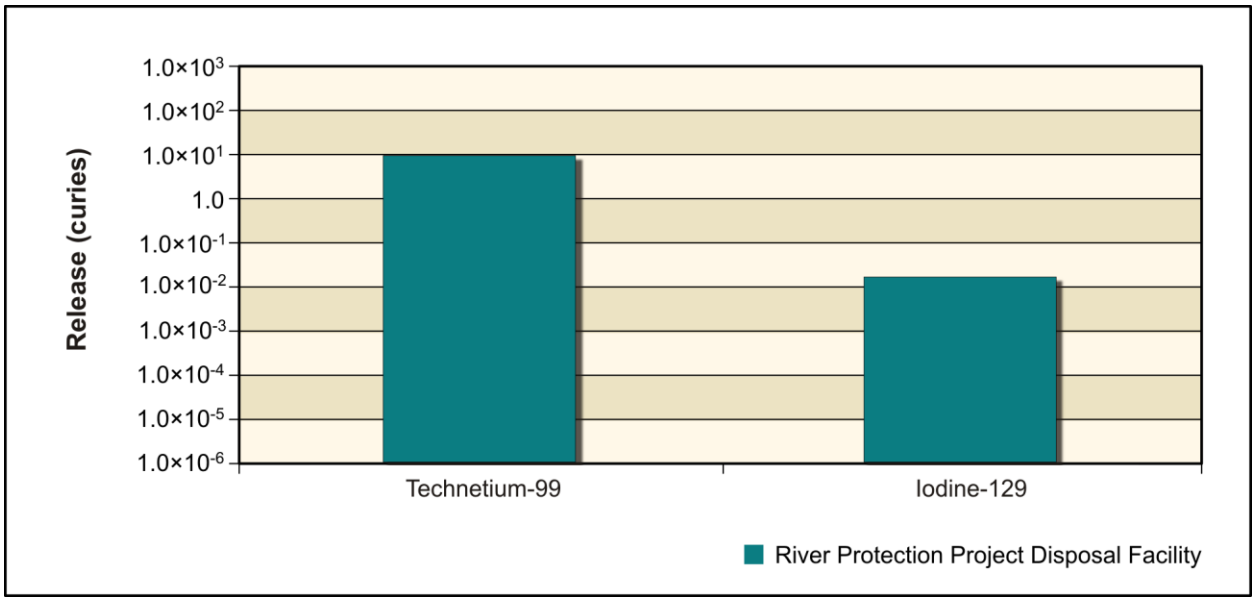


Figure 5–478. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

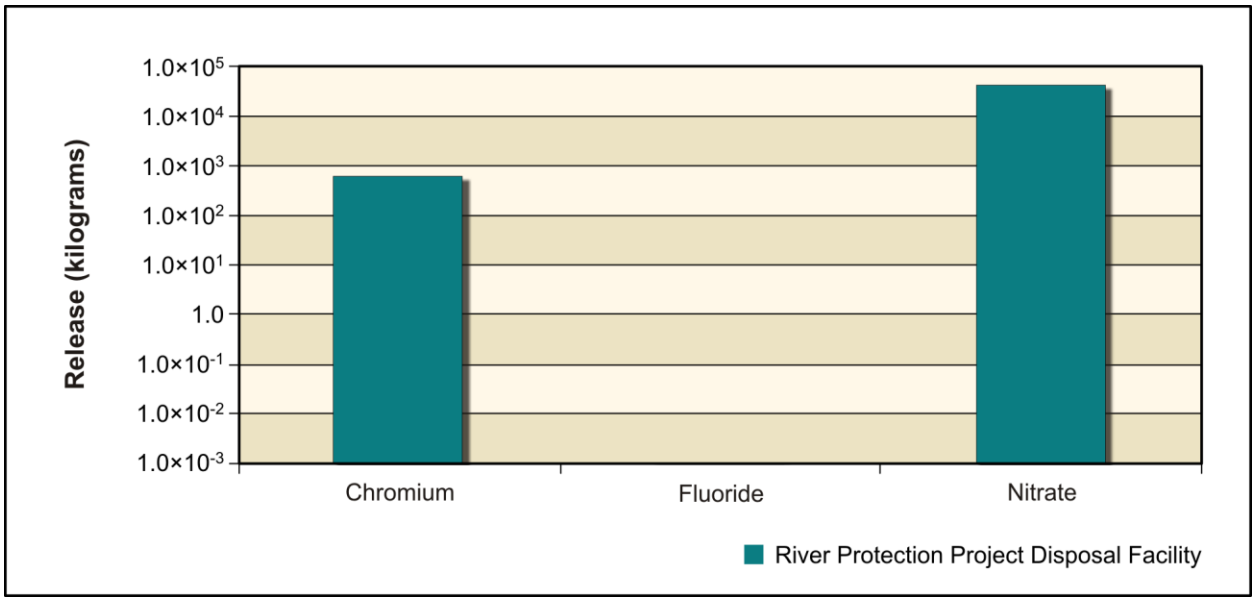


Figure 5–479. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, impacts in terms of groundwater concentration versus time at the RPPDF barrier, IDF-East barrier, Core Zone Boundary, and Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures5–480 through 5–484). The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over five orders of magnitude.

Table 5–97 lists the maximum concentrations of the COPCs in the peak year at IDF-East and the RPPDF, Core Zone Boundary, and Columbia River nearshore. Under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, peak concentrations of technetium-99 and iodine-129 exceed their benchmarks at IDF-East in CY 8054 and CY 7907, respectively. Iodine-129 also reaches its benchmark concentration at the Core Zone Boundary (CY 7856) and approaches the benchmark at the Columbia River nearshore (CY 7749). No other constituents exceed their benchmark concentrations under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D.

Figures 5–480 through 5–483 show the concentration-versus-time plot for technetium-99, iodine-129, chromium, and nitrate (the conservative tracers). For technetium-99, a rise in concentration is evident at the RPPDF barrier, Core Zone Boundary, and Columbia River nearshore that peaks around CY 3940 at over an order of magnitude below the benchmark concentration before decreasing until about CY 4500. Beginning around CY 4500, concentrations at the Core Zone Boundary, Columbia River nearshore, and IDF-East barrier begin climbing again. This second peak causes technetium-99 concentrations at the IDF-East barrier to exceed the benchmark by less than an order of magnitude from about CY 6940 until the end of the period of analysis. Iodine-129 follows a pattern similar to that of technetium-99, reaching a concentration slightly above the benchmark at IDF-East, while chromium and nitrate concentrations never exceed the benchmark.

Table 5–97. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Maximum COPC Concentrations in the Peak Year at IDF-East and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)					
Technetium-99	**1,390** (8054)	42 (3818)	610 (8237)	486 (8130)	900
Iodine-129	**2.2** (7907)	0.1 (3747)	1.0 (7856)	0.7 (7749)	1
Chemical (micrograms per liter)					
Chromium	19 (11,378)	3 (3740)	6 (10,691)	5 (11,049)	100
Nitrate	11,500 (8207)	180 (3670)	3,150 (8121)	2,400 (7899)	45,000

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

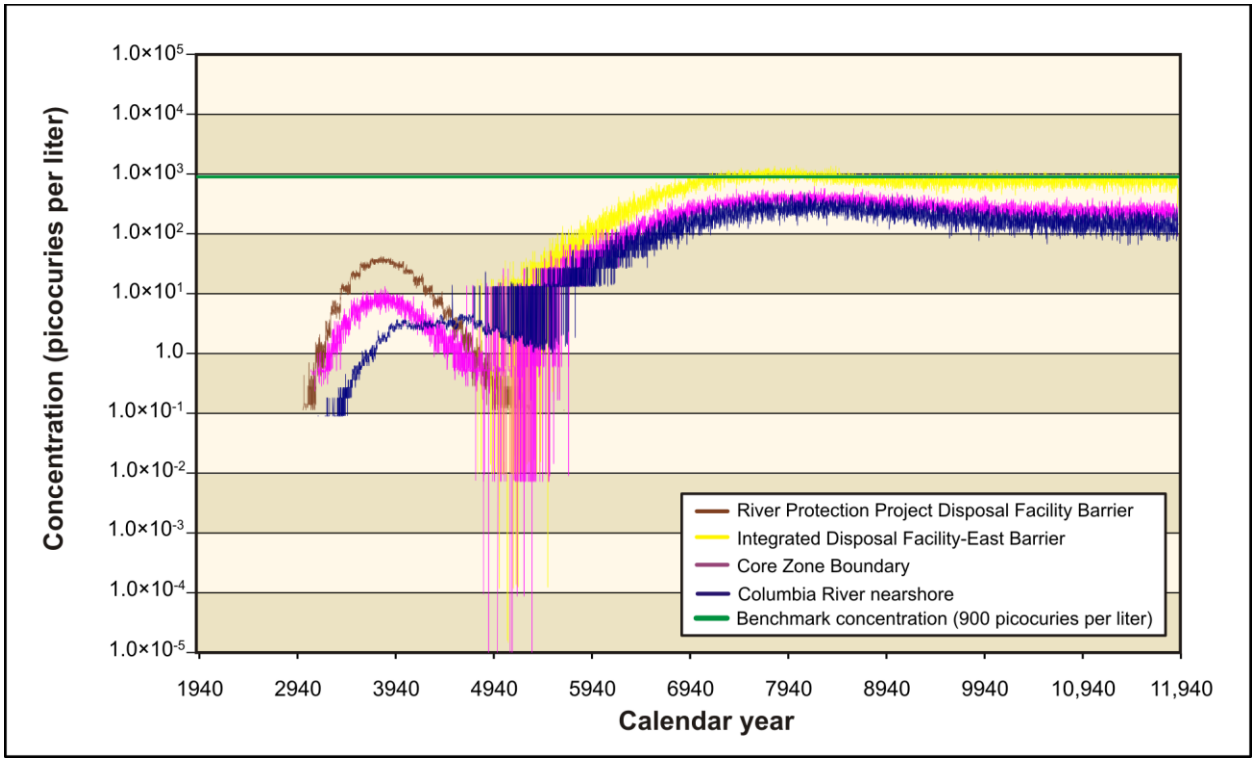


Figure 5–480. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Technetium-99 Concentration Versus Time

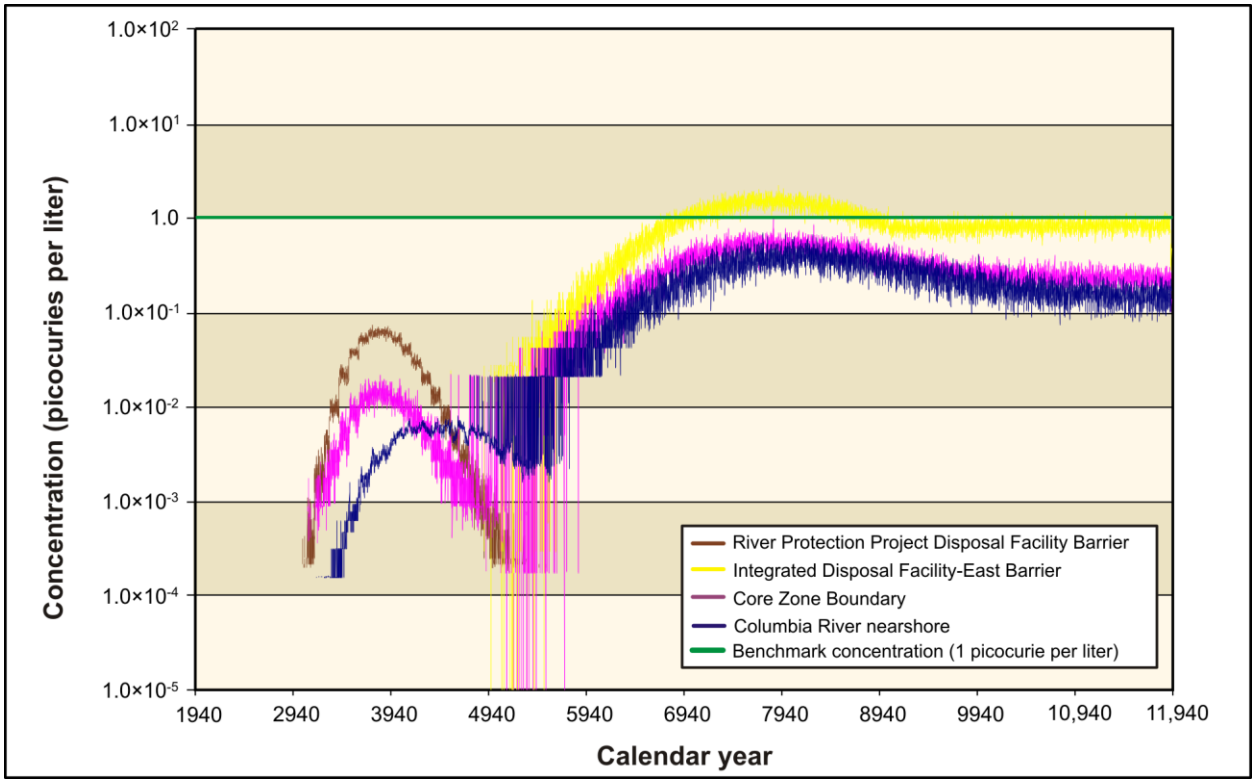


Figure 5–481. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Iodine-129 Concentration Versus Time

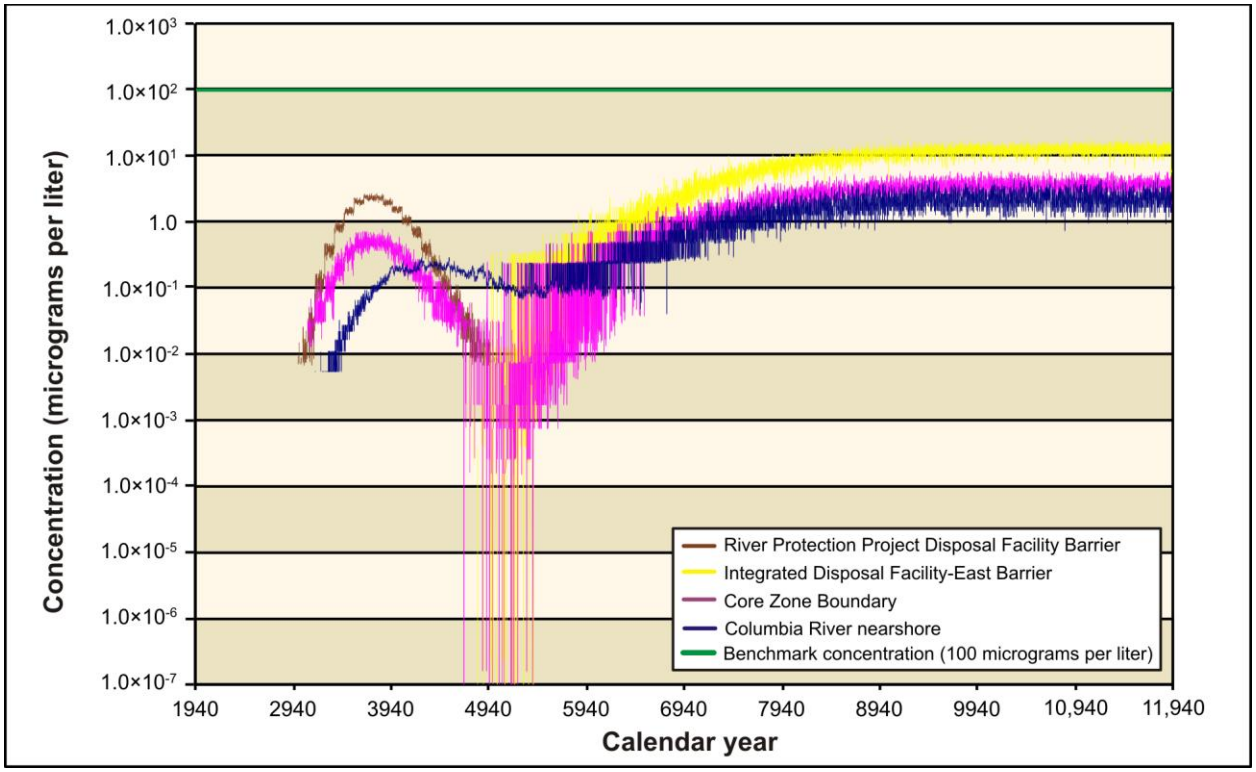


Figure 5–482. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Chromium Concentration Versus Time

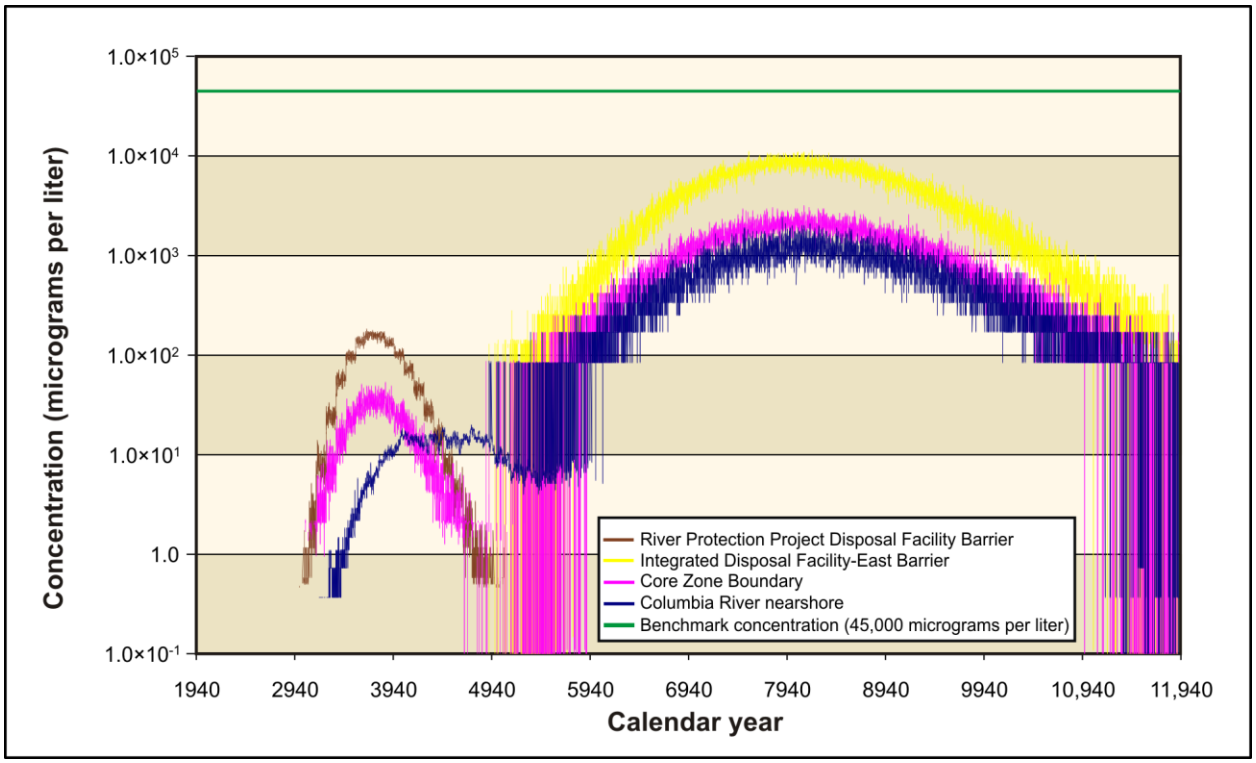


Figure 5–483. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Nitrate Concentration Versus Time

Figure 5–484 shows the concentration-versus-time plot for total uranium. It is not until around CY 9500 that concentrations begin to appear on the graph. The concentrations at the RPPDF barrier, Core Zone Boundary, and Columbia River nearshore all remain over six orders of magnitude below the benchmark level.

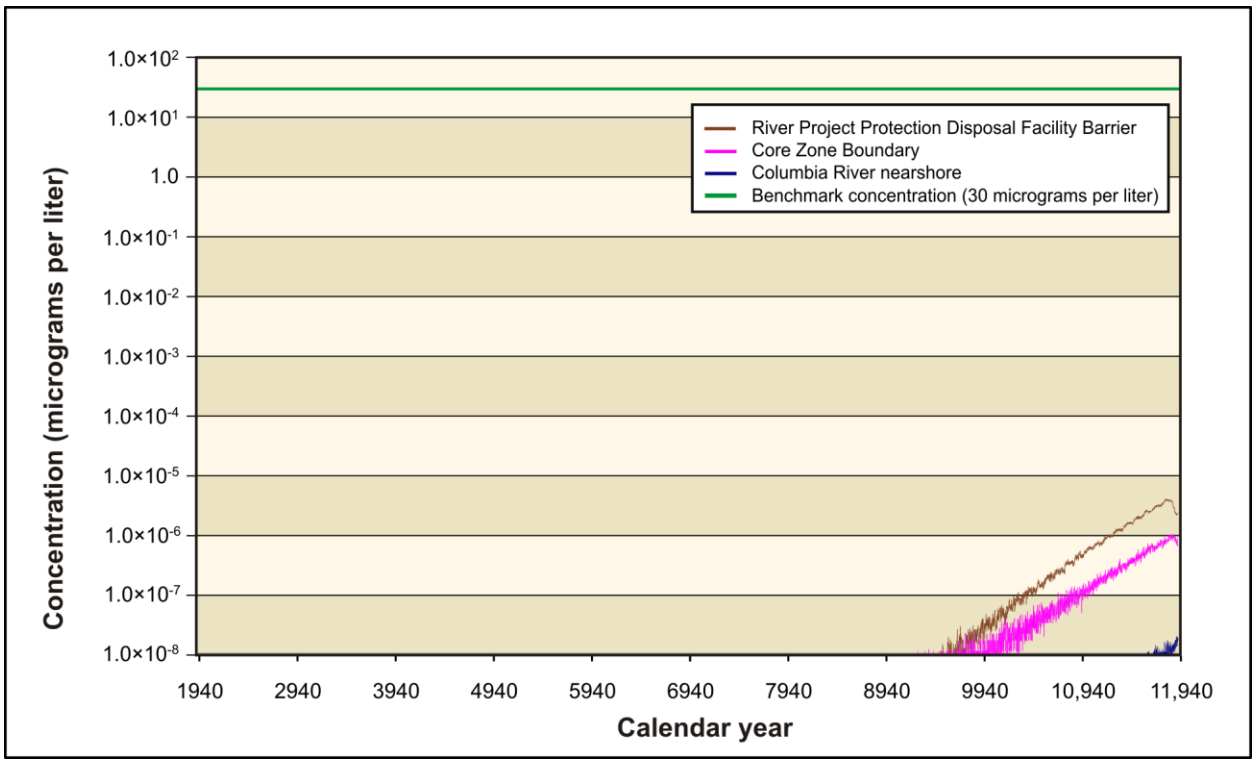


Figure 5–484. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Total Uranium Concentration Versus Time

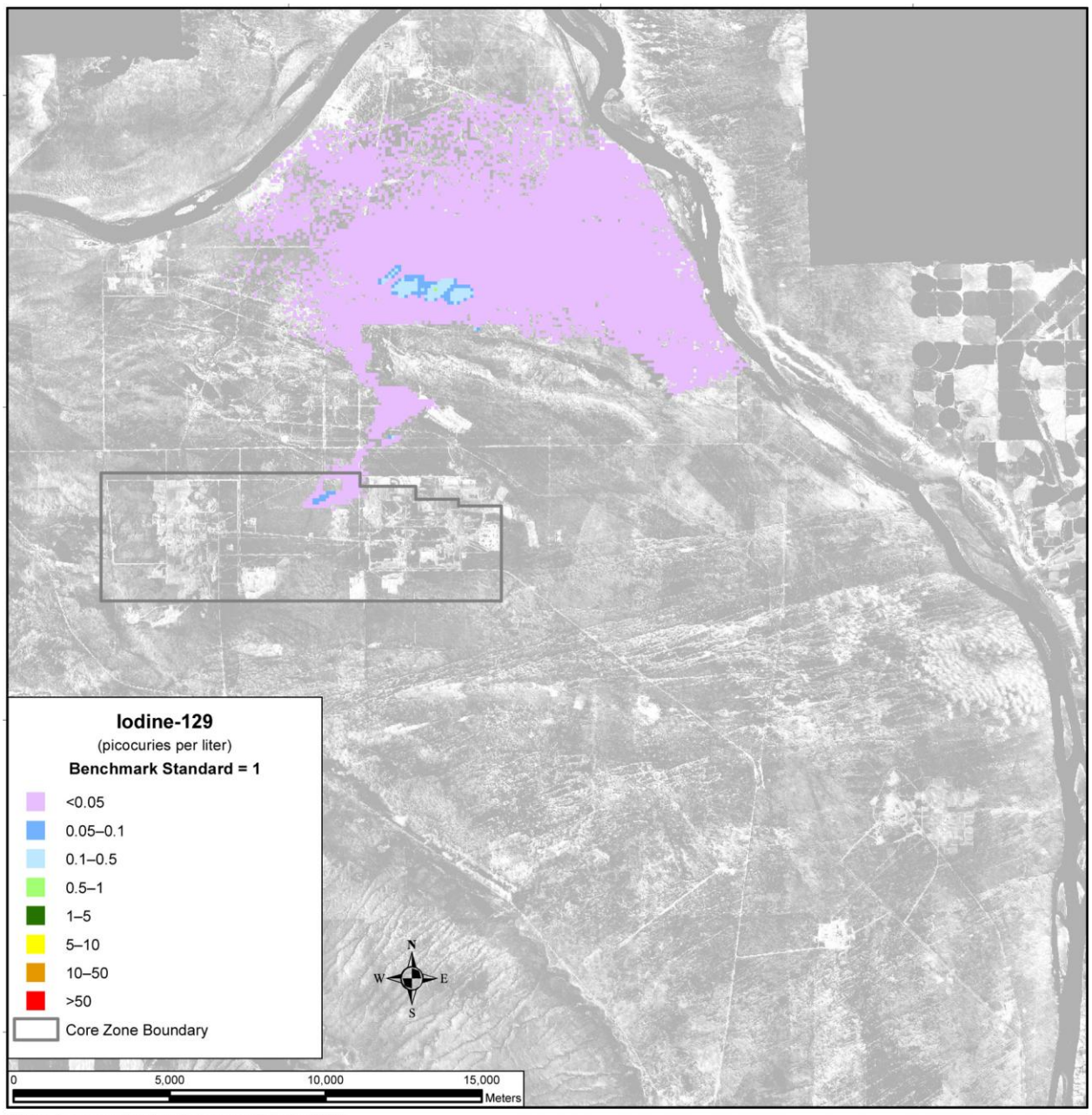
ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Disposal Group 1, Subgroup 1-D, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

Figure 5–485 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890. Releases from the RPPDF create a plume extending north through Gable Gap toward the Columbia River. Peak concentrations in this plume are only one-tenth to one-half of the benchmark. By CY 7140, the RPPDF plume has dissipated, but releases from IDF-East create a new plume extending east toward the Columbia River (see Figure 5–486). Peak concentrations in this plume exceed the benchmark by one to five times. By the end of the period of analysis (CY 11,885), the IDF-East plume's spatial distribution and peak concentrations are about the same as in CY 7140 (see Figure 5–487). Technetium-99 shows a similar spatial distribution over time (see Figures 5–488 through 5–490). Chromium and nitrate also show a similar spatial distribution over time, but with less-intense areas of peak concentration (see Figures 5–491 through 5–496).

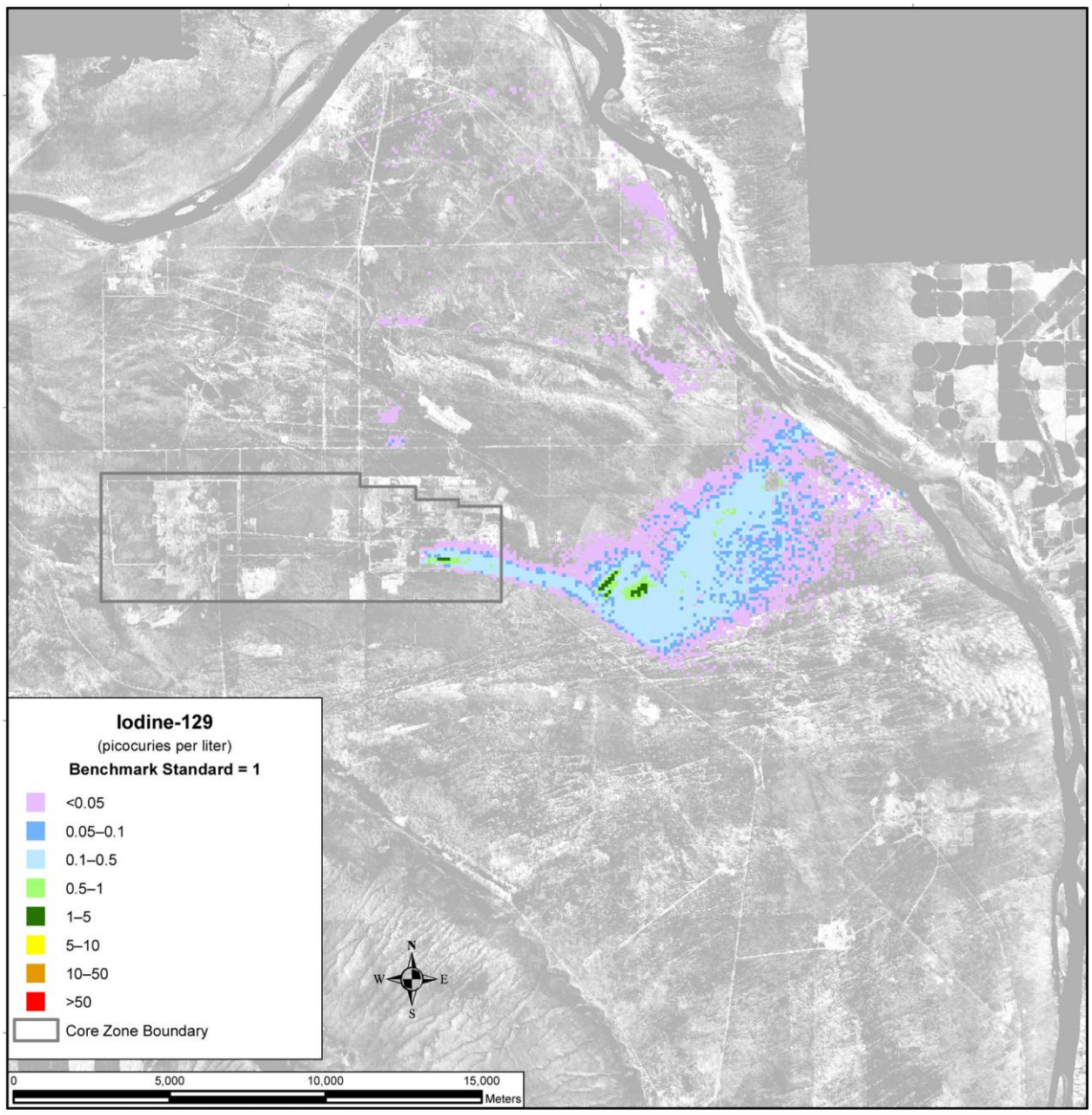
Total uranium is not as mobile as the COPCs discussed above, moving about seven times more slowly than the pore-water velocity. As a result, travel times through the vadose zone are longer, release to the aquifer is delayed, and travel times through the aquifer to the Columbia River are longer. Figure 5–497 shows the distribution of total uranium in CY 11,885. A plume that is less than one-twentieth of the

benchmark is released from the RPPDF and extends north through Gable Gap toward the Columbia River. Because of the retarded nature of the total uranium velocity relative to groundwater, most of the uranium releases are expected to occur after the period of analysis is over.



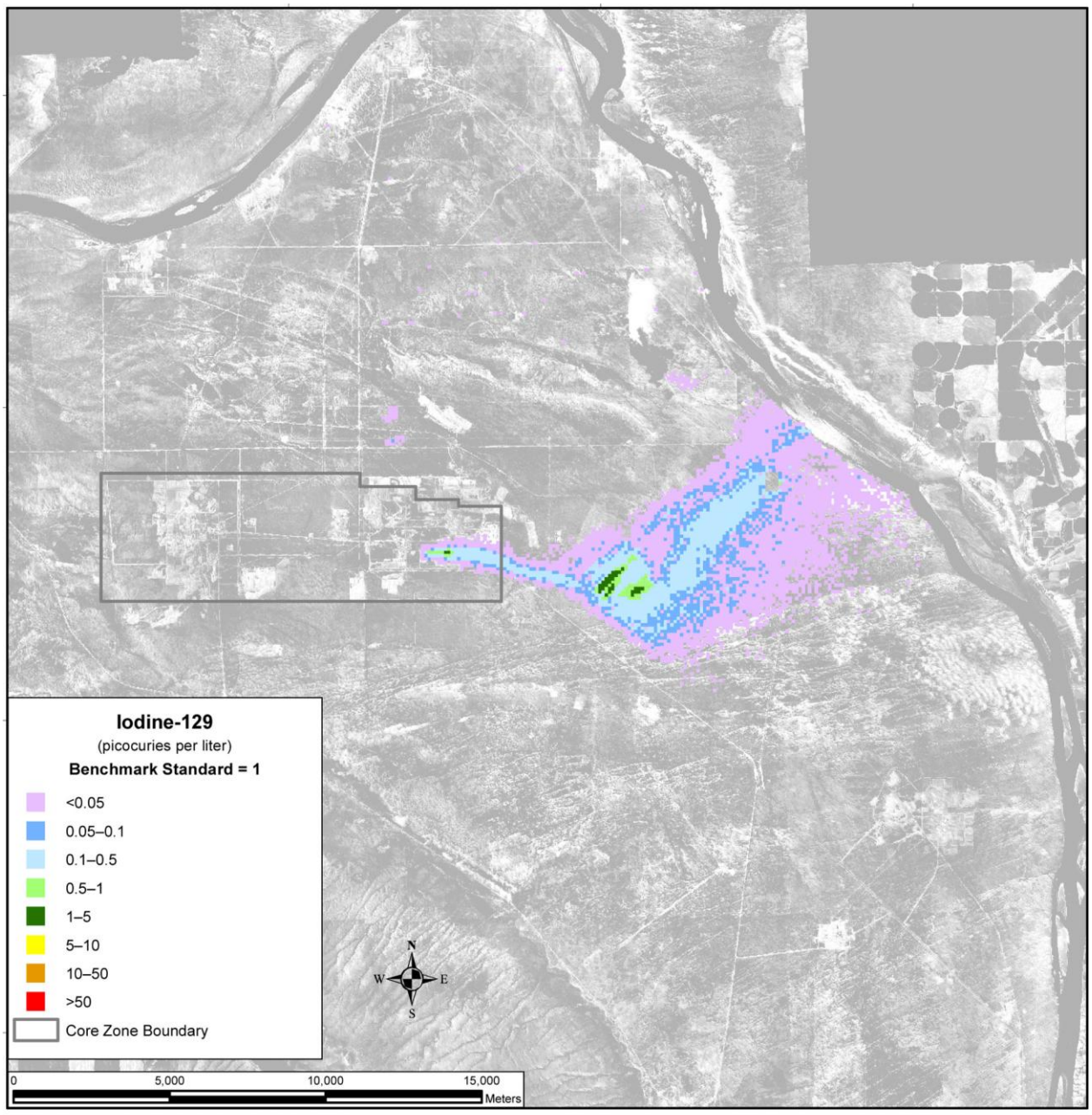
Note: To convert meters to feet, multiply by 3.281.

Figure 5–485. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



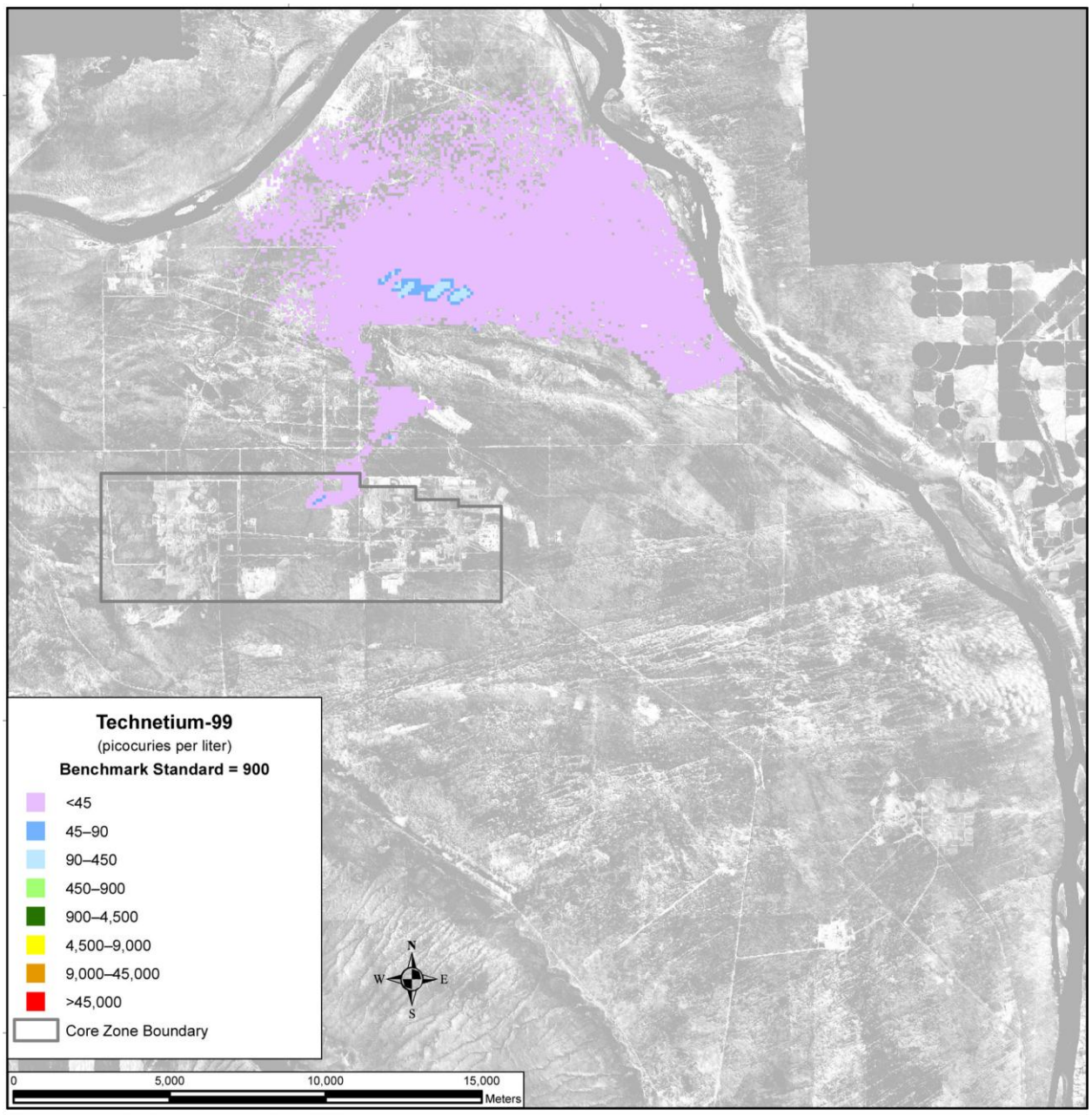
Note: To convert meters to feet, multiply by 3.281.

Figure 5–486. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



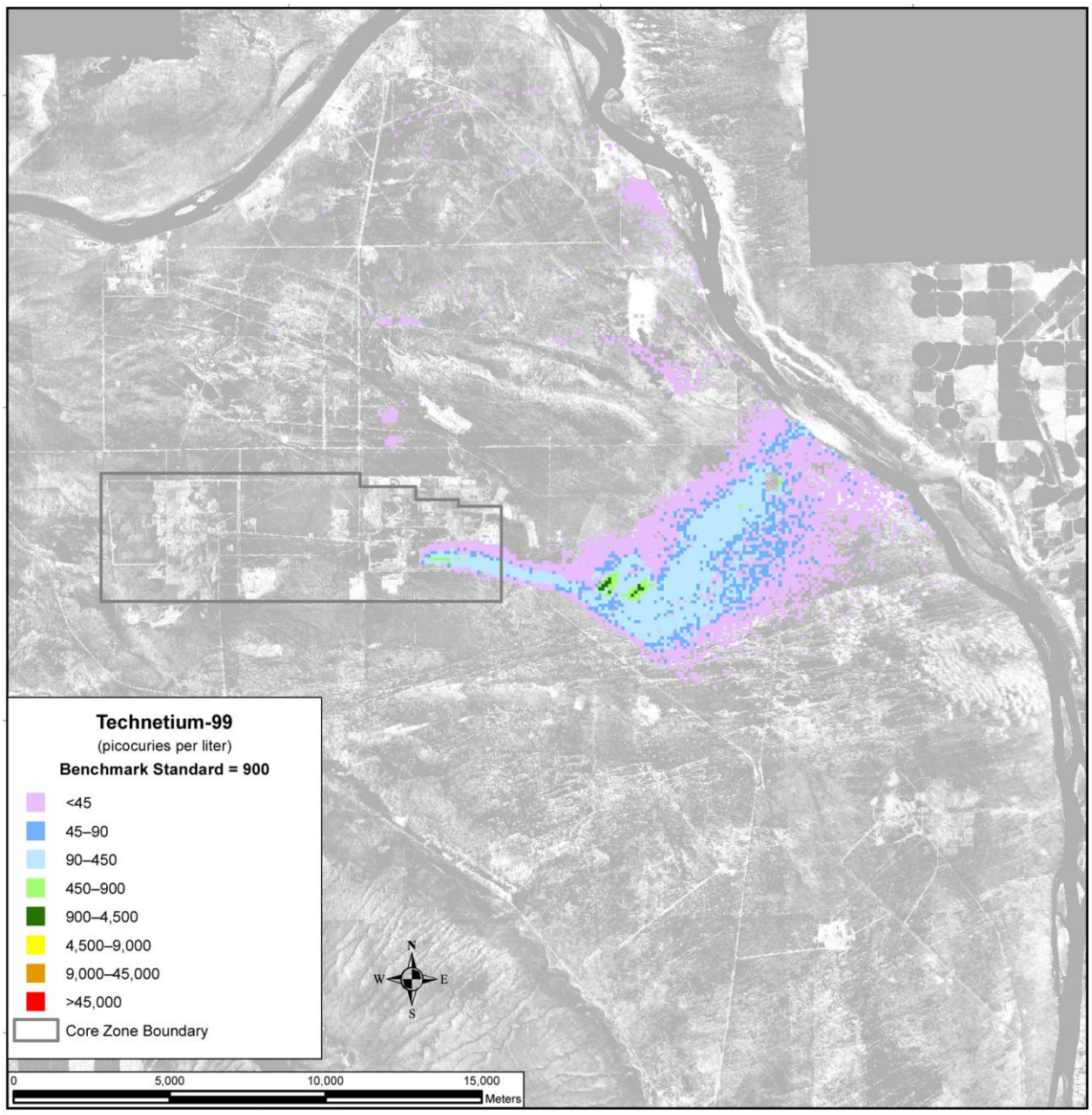
Note: To convert meters to feet, multiply by 3.281.

Figure 5–487. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



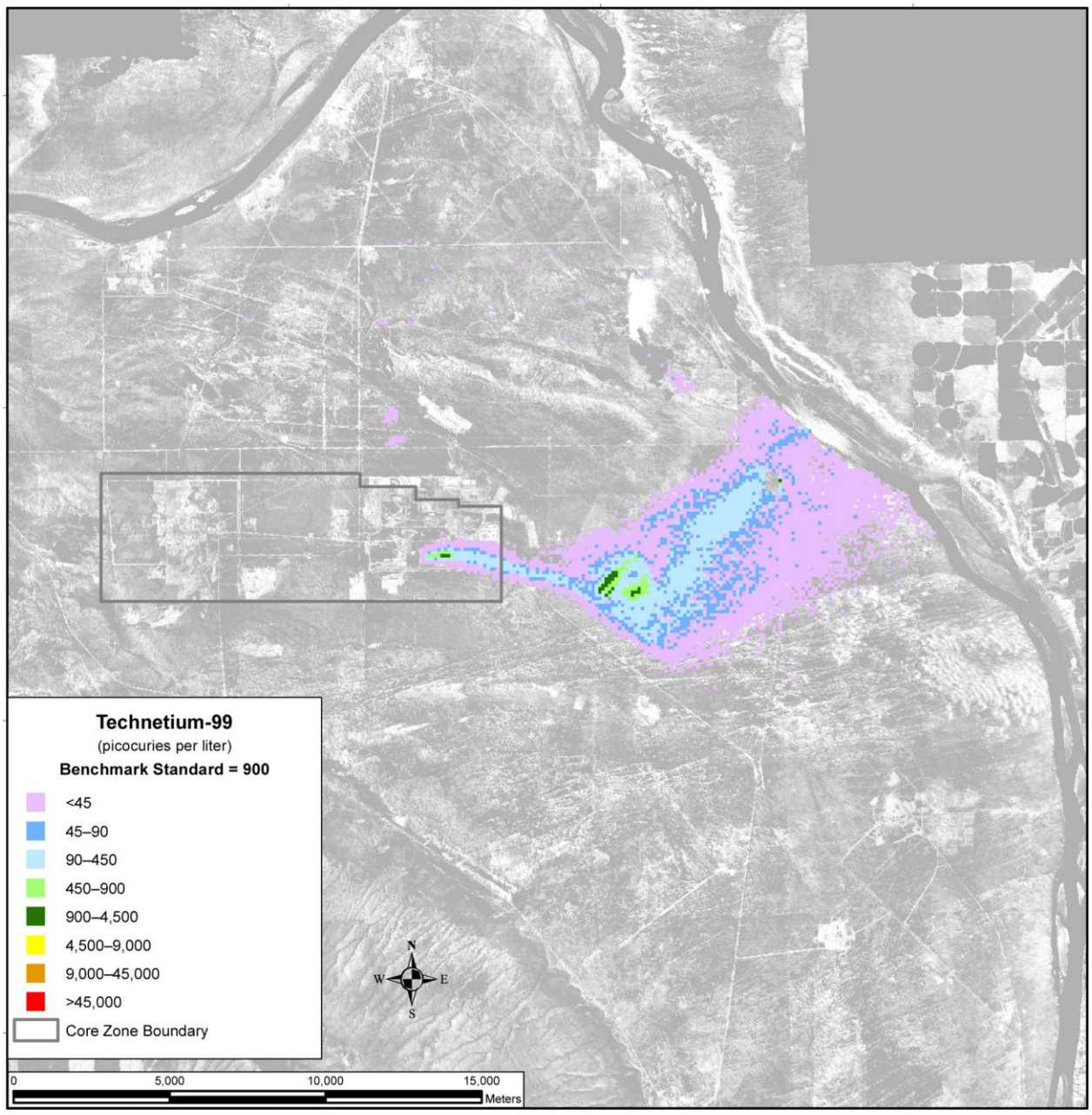
Note: To convert meters to feet, multiply by 3.281.

Figure 5–488. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–489. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–490. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885